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Die Effektivität von experimentellen Akzeptanzstrategien bei akutem Schmerz

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Zusammenfassung

Die Akzeptanz und Commitment Therapie (ACT) ist ein Verfahren der dritten Welle der Psychotherapie. Seitdem ACT durch positive Therapieforschungsbefunde u.a. im Bereich der Schmerzstörungen in den Fokus der wissenschaftlichen Betrachtung gerückt ist, erfreuen sich auch akzeptanzbasierte Interventionen in ihrer Anwendung größerer Beliebtheit. Mehrere experimentelle Studien verglichen die Wirksamkeit von Akzeptanzstrategien und von Strategien zur Ablenkung oder Unterdrückung auf Schmerztoleranz und Schmerzintensität (Branstetter-Rost, Cushing, & Douleh, 2009; Gutiérrez, Luciano, Rodríguez, & Fink, 2004; Hayes, Bissett, et al., 1999; Páez-Blarrina, Luciano, Gutiérrez-Martínez, Valdivia, Rodríguez-Valverde, et al., 2008). Dabei ergaben sich widersprüchliche Befunde hinsichtlich der Überlegenheit der einen oder anderen Strategie.

Die vorliegende kumulative Dissertation setzt sich aus drei Studien zusammen. Die erste Studie verschaffte einen Überblick über die bisherige experimentelle Datenlage, in dem mithilfe einer meta-analytischen Übersichtsarbeit Akzeptanzstrategien mit anderen Emotionsregulations-Strategien hinsichtlich verschiedener Zielvariablen verglichen wurden (Kohl, Rief, & Glombiewski, 2012c). Bezüglich des Einflusses auf Schmerztoleranz bestätigte sich die Überlegenheit von Akzeptanzstrategien. Keine signifikanten Unterschiede zwischen Akzeptanz und anderen Emotionsregulations-Strategien konnten bezüglich der Schmerzintensität gefunden werden. Die Studie zeigte den Forschungsbedarf hinsichtlich des Vergleichs von Akzeptanzstrategien und solchen zur kognitiven Umstrukturierung auf, der im Bereich der Schmerzstörungen bisher nicht gestillt worden war. Daher wurde in der zweiten, experimentellen Studie der Effekt von Akzeptanz, kognitiver Umstrukturierung und Ablenkung auf Schmerztoleranz und -Intensität mithilfe eines Messwiederholungsdesigns bei Gesunden überprüft (Kohl, Rief, & Glombiewski, 2012a). Die Ergebnisse weisen darauf hin, dass Akzeptanz gegenüber kognitiver Umstrukturierung in Bezug auf die Erhöhung der Schmerztoleranz überlegen war. Die Schmerzintensität wurde hingegen in größerem Maße durch Ablenkung als durch Akzeptanz beeinflusst.

Neben mangelnder Forschung bezüglich Strategien der kognitiven Umstrukturierung, basierten die meisten Ergebnisse der in der meta-analytischen Übersichtsarbeit beleuchteten Studien auf gesunden Stichproben, was die Generalisierbarkeit der Befunde auf klinische Populationen einschränkte. Daher wurden in einer dritten Studie mit Fibromyalgiepatienten die Strategien Akzeptanz und kognitive Umstrukturierung einer Kontrollbedingung gegenübergestellt (Kohl, Rief, & Glombiewski, 2012b). Hierbei zeigte sich, dass sowohl Akzeptanz als auch kognitive Umstrukturierung die Hitzetoleranz stärker verbesserten als die

Kontrollbedingung. Bezüglich der Kältetoleranz zeigte sich die Überlegenheit zur Kontrollbedingung nur in der Bedingung zur kognitiven Umstrukturierung. Responder-Analysen ergaben, dass es nur Patienten aus den aktiven Bedingungen (Akzeptanz und kognitive Umstrukturierung) gelang, die Schmerzintensität um 30% zu reduzieren.

Die Ergebnisse des Dissertationsprojekts legen nahe, dass die Unterschiede in der Wirksamkeit zwischen den untersuchten Strategien zum einen von den Zielvariablen abhängen und zum anderen bei Gesunden und Patienten unterschiedlich ausfallen. Es besteht weiterhin Forschungsbedarf, um die Ergebnisse an anderen Stichproben zu validieren und um mögliche Moderatoren des Ansprechens auf die Instruktionen zu identifizieren, damit die Zuweisung zur einen oder anderen Therapieform gezielter vollzogen werden kann.

Summary in English

Acceptance and Commitment Therapy (ACT) belongs to the so-called third wave of cognitive behavior therapy. Since a growing body of research has focused on ACT, e.g. in the field of pain research, acceptance strategies have gained increased popularity. Numerous experimental studies compared the effectiveness of acceptance strategies to distraction and suppression strategies with respect to pain tolerance and intensity (Branstetter-Rost et al., 2009; Gutiérrez et al., 2004; Páez-Blarrina, Luciano, Gutiérrez-Martínez, Valdivia, Rodríguez-Valverde, et al., 2008). Contradictory results were obtained regarding superiority of one or the other strategy.

The present dissertation project includes three different studies. The first study, through a meta-analytic review, provided an overview of results of experimental studies which compare acceptance to other emotion regulation strategies with respect to different outcomes (Kohl et al., 2012c). Acceptance strategies were superior to other emotion regulation strategies in increasing pain tolerance. No differences between strategies were found with respect to pain intensity. The meta-analytic review also indicated the lack of experimental studies that compare acceptance strategies to strategies that aim at cognitively restructure pain related thoughts. Therefore, the second experimental study investigated the effects of acceptance, cognitive restructuring and distraction on pain tolerance and intensity in healthy participants (Kohl et al., 2012a). A mixed within-between design was employed. The study found that acceptance was more effective in increasing pain tolerance than cognitive restructuring, whereas distraction led to lower pain intensity than acceptance. Most of the studies included in the meta-analytic review were based on a healthy sample of participants, which limits generalizability of findings for clinical populations. Therefore, the third study compared acceptance and cognitive restructuring to a control condition in a sample of fibromyalgia

patients (Kohl et al., 2012b). Results indicated that acceptance and cognitive restructuring were superior to the control condition in increasing heat pain tolerance. Cognitive restructuring was also more effective in increasing cold pain tolerance than the control condition. Responder analyses showed that only patients of the two active conditions (acceptance and cognitive restructuring) were able to reduce pain intensity more than 30%.

Results of the dissertation project indicate that differences within effectiveness depend on outcome measures and sample type (healthy vs. clinical samples). It is necessary to validate these results with further studies, and to identify possible moderators of therapeutic success, in order to optimize the allocation of patients to one or the other kind of psychotherapy.

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1. Einführung

Die vorliegende Dissertation beschäftigt sich mit dem Vergleich der Effektivität von experimentellen Akzeptanzstrategien und anderen Emotionsregulations-Strategien bei akutem Schmerz. Zunächst werden chronische Schmerzen definiert und deren Bedeutung auf individueller und gesellschaftlicher Ebene herausgearbeitet sowie ein Entstehungsmodell vorgestellt. Die Darstellung des übergeordneten Störungsbilds chronischer Schmerzen erscheint sinnvoll, um die Erforschung von Behandlungsmöglichkeiten auf Mikroprozess-Ebene (akuter Schmerz) in den Kontext chronischer Schmerzen einordnen zu können. Da im Chronfizierungsprozess des Schmerzgeschehens der Emotion Angst eine wichtige Bedeutung beigemessen wird, sollen Zusammenhänge zwischen Schmerz und der Regulation von Emotionen beleuchtet werden. Daraufhin sollen sowohl traditionelle wie neuere Therapieformen zur Behandlung chronischer Schmerzen dargestellt werden. Ableitbare und zu isolierende Strategien der Therapieformen werden vorgestellt. Anschließend werden aus den offenen Forschungsfragen die Zielsetzung der Dissertation und das konkrete Vorgehen abgeleitet. Nach der Zusammenfassung der einzelnen Studien, sollen in der Diskussion die Vor- und Nachteile der Dissertation Beachtung finden. Abschließend wird ein Fazit dargestellt.

1. 1 Definition und Bedeutung chronischer Schmerzen

Die Definition von chronischem Schmerz bezieht sich in vielen Studien auf die zeitliche Dauer von Schmerzen zwischen mindestens vier Wochen und mindestens zwölf Monaten (Raspe, Hüppe, & Matthis, 2003). Zur Verfeinerung des Konzepts wurde daher ein Modell vorgeschlagen, das sowohl die zeitliche und räumliche Ausbreitung von Schmerzen als auch die Ausweitung auf weitere somatische Systeme und auf das psychische System inkludiert (Raspe et al., 2003). Auch wenn die wissenschaftliche Definition von chronischem Schmerz einige Hürden mit sich bringt, so ist sicher, dass chronischer Schmerz nicht nur für den Betroffenen ein ernstzunehmendes Problem ist. Betroffene leiden unter Funktionseinschränkungen durch den „ständigen Begleiter“ Schmerz und daher unter Einbußen der Lebensqualität. Gleichwohl verursacht chronischer Schmerz durch seine weite Verbreitung auch auf der gesellschaftlichen Ebene immense sozioökonomische Folgen:

Die Prävalenz von moderaten bis starken chronischen Schmerzen in der europäischen Bevölkerung liegt bei 19% (Breivik, Collett, Ventafridda, Cohen, & Gallacher, 2006). In der Erhebung zeigte sich zugleich, dass nur wenige Patienten von Spezialisten behandelt werden. In der deutschen Bevölkerung liegt die 1-Jahresprävalenz für Rückenschmerz bei 76%

(Schmidt et al., 2007). Die sozioökonomischen Konsequenzen von chronischen Schmerzen werden oftmals unterschätzt (Blyth, March, Nicholas, & Cousins, 2003; Göbel, 2001; Kohlmann et al., 2007; Maetzel & Li, 2002; Wenig, Schmidt, Kohlmann, & Schweikert, 2009). Dabei zeigte sich nicht nur, dass chronischer Schmerz zu hohen Arbeitsunfähigkeitszeiten und hohen Behandlungskosten führt, sondern dass auch die Arbeitsleistung davon betroffen ist.

Das Fibromyalgiesyndrom ist definiert durch weit verbreiteten Schmerz und sogenannte schmerzhafte „tender points“ (Druckschmerzpunkte) (Wolfe et al., 1990). Neuere Konzepte schlagen vor, auch Fatigue, unerholsamen Schlaf, kognitive Probleme und eine Mannigfaltigkeit von Symptomen zur diagnostischen Einschätzung hinzu zuziehen (Wolfe, 2010). Prävalenzschätzungen gehen von 2 bis 5% aus (Branco et al., 2010; Lindell, Bergman, Petersson, Jacobsson, & Herrström, 2000; Wolfe, Ross, Anderson, Russell, & Hebert, 1995). Auch das Fibromyalgiesyndrom ist mit sozioökonomischen Kosten verknüpft (Spaeth, 2009). Im Vergleich zu anderen chronischen Schmerzpatienten weisen Fibromyalgiepatienten spezifische Charakteristika auf: Studien zeigten eine geringere Schmerztoleranz und eine höhere Schmerzvigilanz (Crombez, Eccleston, Van den Broeck, Goubert, & Van Houdenhove, 2004; McDermid, Rollman, & McCain, 1996).

Aufgrund der individuellen als auch der gesellschaftlichen Bedeutung chronischer Schmerzen ist neben medizinischen Behandlungsmöglichkeiten die Erforschung von wirksamen psychologischen Behandlungsmöglichkeiten wichtig.

1.2 Modellannahmen

Zur Erklärung, weshalb akuter Schmerz zur chronischen Erscheinung wird, kann das biopsychosoziale Fear-Avoidance Modell herangezogen werden (siehe Abbildung 1; Vlaeyen & Linton, 2000, 2012). Ein *Schmerz*, der z.B. durch eine *Verletzung* entsteht wird dabei als unkonditionierter Stimulus (US) betrachtet, der durch die bedrohliche *Bewertung* und der daraufhin entstehenden *Furchtreaktion* defensive Mechanismen wie *Vermeidung* (konditionierte Reaktion, CR) initiiert. Es erfolgt die Antizipation des US durch die Assoziation mit einem konditionierten Stimulus (CS). Propriozeptive und interozeptive konditionierte Stimuli (CS) dienen dabei als Prädiktoren für den US.

Der Bewertung von Schmerz wird dabei eine zentrale Rolle zugeschrieben. Wird das innere Ereignis durch *Katastrophisieren* als bedrohlich erachtet, entsteht Furcht. Mit der schmerzbezogenen Angst geht die Erhöhung der physiologischen Aktivität (z.B. erhöhte

Muskelspannung) einher (Norton & Asmundson, 2003). Diese Angst löst dann als Konsequenz Vermeidung alltäglicher *Aktivitäten* aus, und kann somit ggfs. auch zu einem *Verstärkerverlust* und weiteren Beeinträchtigungen (z.B. Depression) führen. Die Verminderung von Aktivität hat zudem ebenfalls Auswirkungen auf das muskolo-skeletale System, was sich in einem allgemein reduzierten körperlichen Zustand niederschlagen kann. Die Vermeidung tritt in der Folge schon als Antizipation des Schmerzes auf, wodurch korrigierende Erfahrungen nicht erlebt werden.

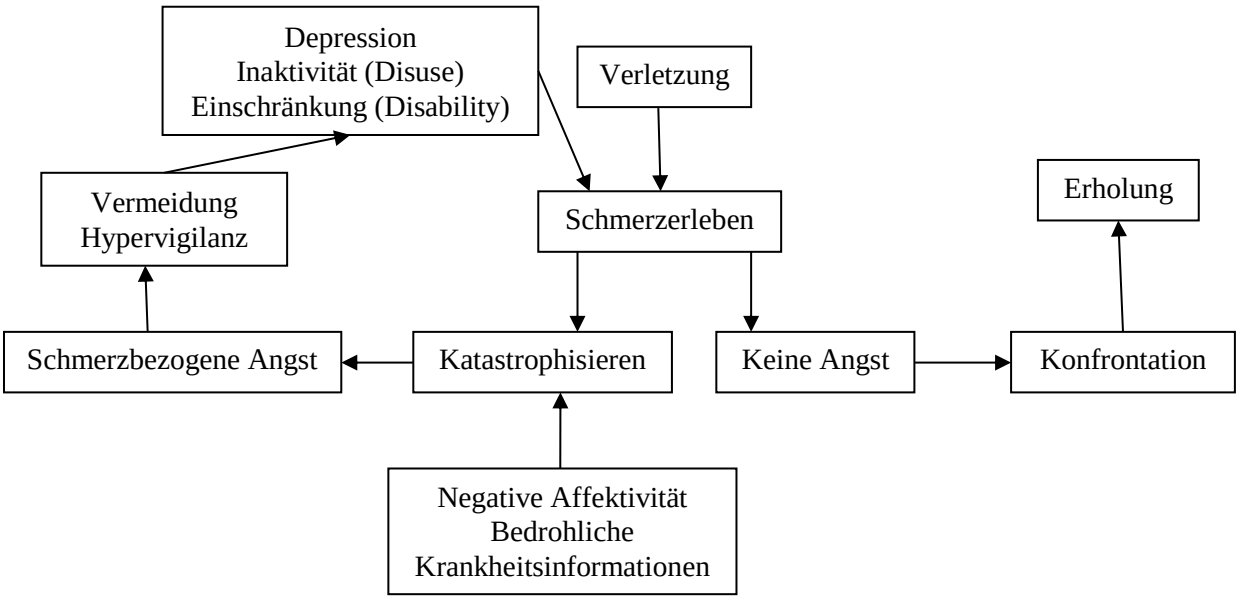

Abbildung 1: Fear-Avoidance Modell der chronischen Schmerzentstehung (Vlaeyen & Linton, 2000, 2012)

Neben der Vermeidung bewirkt die schmerzbezogene Angst, dass auch vermehrt kognitive Kapazität in Form von erhöhter *Aufmerksamkeit* auf bedrohliche Reize (Hypervigilanz) benötigt wird. Dadurch entsteht ein Rückkopplungsmechanismus zur Bewertung, die durch das Einholen kongruenter Informationen weiter gesichert wird.

Das Modell verdeutlicht, dass in der Behandlung von chronischem Schmerz kognitiven, emotionalen und verhaltensbezogenen Faktoren eine wichtige Rolle zukommt. Der Übersichtsartikel von Vlaeyen und Linton (2012) betont, dass das Modell in seinen Grundannahmen durch bisherige Forschungsarbeiten gut belegt ist.

1.3 Exkurs zum Modell der Emotionsregulation

Damit die Relevanz von emotionalen Prozessen im Schmerzgeschehen Berücksichtigung findet, soll im Folgenden ein Modell der Emotionsregulation dargestellt werden. Gross (1998) beschreibt fünf Phasen in der Regulation von Emotionen (siehe Abbildung 2).

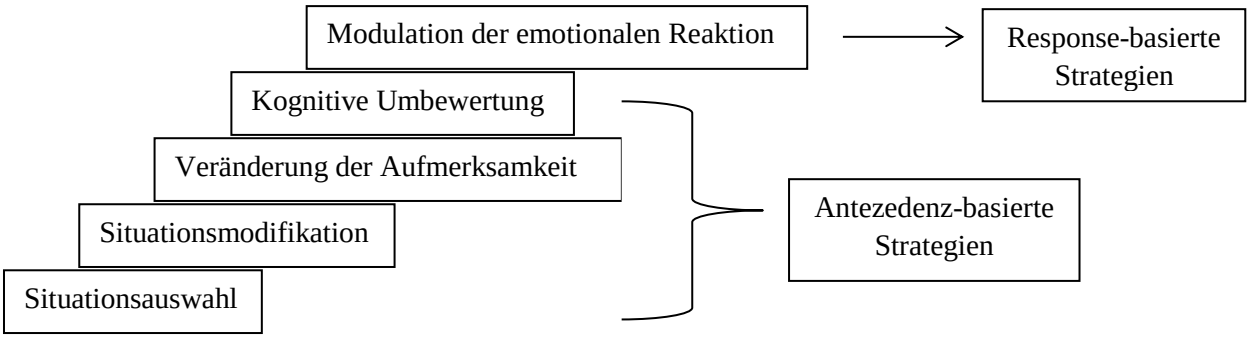

Abbildung 2: Emotionsregulationsmodell von Gross (1998)

Die erste Phase bezieht sich auf die Situationsauswahl, in der Menschen durch die Annäherung oder die Vermeidung von Personen, Orten oder Objekten Emotionen regulieren. Innerhalb der zweiten Regulationsphase erfolgt die Modifikation der Situation. Innerhalb der dritten Phase werden Strategien zur Veränderung des Aufmerksamkeitsfokus angewendet. Innerhalb der vierten Phase erfolgt eine Modifizierung kognitiver Interpretationen oder Bewertungen der Situation. Auf der fünften Stufe tritt eine Modulation der emotionalen Reaktion in Kraft. Diese Modulation bezieht sich auf den Einfluss physiologischer, erfahrungsbasierter und verhaltensbasierter Reaktionen. Gemäß dem Emotionsregulationsmodell von Gross (1998) können Emotionen entweder durch Antezedenz-basierte Strategien reguliert werden, die die Evaluation externaler oder internaler emotionaler Stimuli z.B. durch Umbewertung verändern (Stufen 1 bis 4). Response-fokussierte Strategien wie Akzeptanzstrategien treten zeitlich gesehen nach antezedenten Strategien auf und beziehen sich auf die Veränderung der emotionalen Reaktion (Stufe 5).

1.3.1 Gemeinsamkeiten von Emotion und Schmerz

Sowohl Emotionen als auch das Schmerzerleben sind interne Prozesse. Zudem zeigt das Fear-Avoidance Modell (Vlaeyen & Linton, 2000, 2012), dass Chronifizierungsprozesse durch die Emotion Angst vermittelt werden. Abbildung 3 zeigt, dass sich manche Komponenten des Fear-Avoidance Modells mit den Phasen der Emotionsregulation überlappen und ggfs. mithilfe von Strategien zur Emotionsregulation verändert werden können. Eine Umbewertung

katastrophisierender Überzeugungen würde zu einer Reduktion von Angst führen. Könnte die Reaktion Angst moduliert werden, ergäben sich andere Konsequenzen als Hypervigilanz und Vermeidung. Würde es gelingen, den Fokus der Aufmerksamkeit von schmerzrelevanten Stimuli wegzulenken, könnte ein Ausstieg aus dem Teufelskreis ggfs. erreicht werden. Die Situationsauswahl bestimmt schließlich, ob eine potentiell schmerzerzeugende Situation vermieden wird.

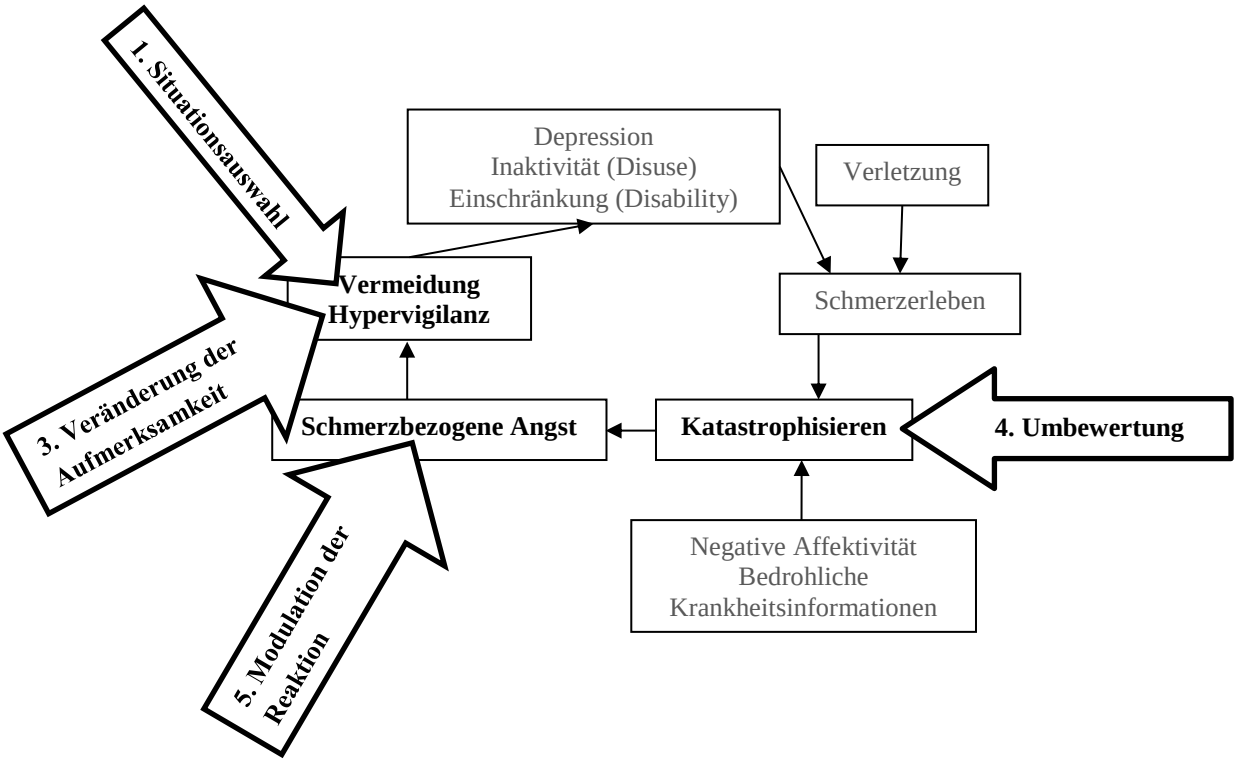

Abbildung 3: Einfluss von Emotionsregulation auf das Fear-Avoidance Modell (Vlaeyen & Linton, 2000, 2012)

Darüber hinaus fanden Studien Zusammenhänge zwischen Emotionen (und deren Regulation) und Schmerz. So zeigte sich zum Beispiel, dass Affektregulation mit vermindertem Schmerzerleben einher ging (Connelly et al., 2007). Patienten, die eine hohe emotionale Intensität aufwiesen und gleichzeitig auch hohe Regulationsstrategien besaßen, konnten am besten auf durch Schmerz ausgelöste Emotionen reagieren (Hamilton, Zautra, & Reich, 2007). Der Zusammenhang zwischen Emotionsregulation und der Schmerzintensität konnte weiterhin bestätigt werden (Paquet, Kergoat, & Dubé, 2005). Auch der Ausdruck von Ärger schien sich auf die Schmerzintensität auszuwirken (Burns, Kubilus, & Bruehl, 2003). Bei Fibromyalgiepatienten scheint die Regulation von Emotionen eine große Rolle zu spielen (van Middendorp et al., 2008).

Die beschriebenen Befunde zeigen, dass der Regulation von Emotionen auch im Bereich der chronischen Schmerzstörung eine wichtige Rolle beigemessen werden sollte und eine erfolgreiche Emotionsregulation das Schmerzerleben zu beeinflussen vermag.

1.4 Kognitive Verhaltenstherapie bei chronischem Schmerz

Kognitiv-behaviorale Methoden in der Behandlung chronischer Schmerzen umfassen Entspannungsübungen, Biofeedback, Veränderung des Aufmerksamkeitsfokus, kognitive Methoden wie Umbewertung und verhaltensnahe Interventionen wie die Ermutigung zu einem höheren Aktivitätslevel (Rief, Exner, & Martin, 2006). Nach Keefe (1996) besteht die kognitive Verhaltenstherapie chronischer Schmerzen aus drei wesentlichen Komponenten: Etablierung eines Therapierationals, Training von Coping-Skills sowie deren Anwendung und Erhaltung.

1.4.1 Wirksamkeit von kognitiver Verhaltenstherapie bei chronischem Schmerz

Verschiedene Studien belegen die Wirksamkeit kognitiver Verhaltenstherapie (KVT) bei chronischem Schmerz, wobei die Effekte zumeist eine mittlere Ausprägung aufweisen (Butler, Chapman, Forman, & Beck, 2006; Eccleston, Williams, & Morley, 2009; Glombiewski, Hartwich-Tersek, & Rief, 2010; Hoffman, Papas, Chatkoff, & Kerns, 2007; van Tulder et al., 2001). Eine weitere Meta-Analyse zeigte jedoch auch, dass nur zwischen einem Drittel und einem Fünftel der Patienten klinisch signifikante Verbesserungen erzielen (Morley, Williams, & Hussain, 2008).

Eine Meta-Analyse konnte zudem die Wirksamkeit von psychologischen Behandlungen von Fibromyalgie belegen (Glombiewski, Sawyer, et al., 2010). Es zeigten sich kleine Effekte psychologischer Behandlungen auf Schmerz, Depression, Katastrophisierung und Schlaf. Eine andere Studie fand hingegen, dass kognitiv-behaviorale Verfahren keinen Einfluss auf Schmerz bei Fibromyalgie hatten (Bernardy, Füber, Köllner, & Häuser, 2010).

Die Forschungslage verdeutlicht, dass bisher nicht alle Patienten von KVT profitieren.

1.5 Einführung in die Akzeptanz und Commitment Therapie

Die Akzeptanz- und Commitment Therapie (ACT) findet als Teil der so genannten *dritten Welle* der Verhaltenstherapie Beachtung. ACT wird auch als kontextuelle Therapieform bezeichnet (Hayes, 2004). Die Therapieform kann durch die folgenden sechs zentralen Prozesse beschrieben werden: **(1) Akzeptanz** bezeichnet dabei die Bereitschaft, gegenwärtige Ereignisse oder Situationen aktiv anzunehmen (Hayes, Strohsal, & Wilson, 1999). Dabei

sollen Gefühle und Empfindungen (auch unangenehmer Art) vollständig wahrgenommen werden ohne dabei diese zu vermeiden, sich derer zu widersetzen oder auf sie mit anderem Verhalten zu reagieren. Ein weiteres Ziel von ACT ist die Veränderung der *Funktion* innerer Ereignisse wie Gedanken und Gefühle und nicht (wie in der KVT) die Veränderung der *Art* oder Häufigkeit von Gedanken oder Gefühlen. Dieser Prozess wird als **(2) Kognitive Defusion** bezeichnet. Das Ziel von **(3) Präsent Sein** ist ein flexibles Verhalten und die Herstellung von Konsistenz zwischen Handlungen und Werten. **(4) Selbst als Kontext** bezieht sich auf die Ermutigung, das Selbst als eine mögliche Perspektive zu betrachten (Hayes, Luoma, Bond, Masuda, & Lillis, 2006). **(5) Werte** sollen in verschiedenen Lebensbereichen gewählt werden, um das Verhalten dementsprechend auszurichten. **(6) Commitment** bezieht sich dann schließlich auf die Handlung gemäß der gewählten Werte durch das Erlernen von Skills, Shaping Methoden u.a. (Hayes, 2004; Hayes et al., 2006; Hayes, Strohsal, et al., 1999).

1.5.1 Akzeptanz und Commitment Therapie bei chronischem Schmerz

Die Akzeptanz und Commitment Therapie versucht Patienten zu vermitteln, dass sie trotz des Schmerzes ihren Werten getreu leben können. Eine wichtige Strategie, den Fokus vom Schmerz wegzulenken ist, Gedanken und Empfindungen nicht als Fakten einzuschätzen. Nicht der Schmerz selbst sei dementsprechend das Problem, sondern die Versuche selbigen zu vermeiden (Eisendrath, 2012). Das Ziel besteht darin, den Kampf mit dem Schmerz zu beenden und die Patienten zu ermutigen, Schmerzen anzunehmen und werteorientierte Handlungen aufzunehmen (Hayes et al., 2006).

1.5.1.1 Wirksamkeit von Akzeptanz und Commitment Therapie bei chronischem Schmerz

Eine Vielzahl von Studien und Meta-Analysen konnte generell die Wirksamkeit von ACT belegen (Hayes, Masuda, Bissett, Luoma, & Guerrero, 2005; Oest, 2008; Powers, Vording, & Emmelkamp, 2009; Pull, 2009). Die Größe der Effektstärken wurde als moderat beschrieben.
Einige Studien konnten zeigen, dass akzeptanzbasierte Therapieverfahren auch effektiv in der Behandlung chronischer Schmerzen waren und dabei vergleichbare Effekte wie kognitiv-verhaltenstherapeutische Verfahren erzielten (Johnston, Foster, Shennan, Starkey, & Johnson, 2010; McCracken, Vowles, & Eccleston, 2005; Veehof, Oskam, Schreurs, & Bohlmeijer, 2011; Vowles & McCracken, 2008; Wetherell et al., 2011). Akzeptanzbasierte Interventionen führten bei chronischen Schmerzpatienten zu signifikanten Verbesserungen im allgemeinen

Funktionsniveau (McCracken & Eccleston, 2005). Auch Variablen wie schmerzbezogene Ängstlichkeit, Laufdistanz und Schmerzintensität konnten durch ein solches Verfahren Verbesserungen erzielen (McCracken et al., 2005; Vowles & McCracken, 2008).
Auch für Fibromyalgie konnten Studien bisher zumindest den Einfluss von Akzeptanz auf den Funktionsstatus und die Beeinträchtigung belegen und die Wichtigkeit des Konstrukts für den Adaptationsprozess bezogen auf chronische Schmerzen nachweisen (Kratz, Davis, & Zautra, 2007; LaChapelle, Lavoie, & Boudreau, 2008).
Ähnlich wie die Forschung zur KVT zeigt sich auch bei dieser neueren Therapierichtung, dass viele, aber längst nicht alle Patienten vom gesamten Therapiepaket „ACT“ profitieren.

1.6 Vergleichende Therapieforschung

Aus den Meta-Analysen über die Wirksamkeit von ACT konnte geschlussfolgert werden, dass ACT zwar effektiv ist, jedoch vermutlich nicht effektiver als KVT (Gaudiano, 2009). Bisher nur eine mir bekannte Studie verglich ACT und KVT bei chronischem Schmerz mithilfe eines randomisierten, kontrollierten Designs (Wetherell et al., 2011). In den Verbesserungen der erhobenen Variablen zeigten sich keine signifikanten Unterschiede zwischen den beiden Verfahren. Patienten, die mit ACT behandelt worden waren, zeigten lediglich eine größere Zufriedenheit als Patienten, die mit KVT behandelt worden waren.

1.6.1 Relevanz experimenteller Studien

Van Damme und Moore (2012) argumentieren, dass es nach einer großen Anzahl an klinischen Therapiestudien, die die Wirksamkeit kognitiv-verhaltenstherapeutischer Programme belegen, notwendig ist einen Schritt zurück zu gehen. Es bleibe ansonsten weiterhin unklar, welcher Baustein des großen KVT-Arsenals für welchen Patienten unter welchen Bedingungen wirkt. Die große Auswahl an Strategien sei eine Herausforderung für Patienten. Auch Vlaeyen und Morley (2005) stellten fest, dass bisher unklar blieb, welche Intervention welchem Patiententyp am besten hilft.
Darüber hinaus stellt sich auch die Frage, welche Intervention Auswirkungen auf welche Zielvariable hat. Wie bereits beschrieben, sieht KVT vor, Gedankeninhalte zu verändern, um auch Verhaltensänderungen zu bewirken. ACT hingegen macht sich zur Aufgabe auf einer meta-kognitiven Ebene gedankliche Prozesse zu hinterfragen, um als Folge werteorientiert zu handeln. KVT lehrt dem Patienten gleichwohl Strategien zur flexibleren Aufmerksamkeitslenkung mit dem Ziel, Schmerzen weniger wahrzunehmen.

Der Vergleich eines potentiell effektiven Verfahrens mit einem bereits als wirksam erwiesenen Verfahren gestaltet sich bezüglich folgender Aspekte als schwierig. Psychologische Behandlungen zeigen durch gemeinsame, unspezifische Mediatoren wie z.B. die therapeutische Beziehung Überlappungen. Innerhalb von Therapiestudien sind solche Effekte schwer zu isolieren. Der Vorteil experimentellen Vorgehens liegt daher darin, dass die Ergebnisse mit einer höheren Wahrscheinlichkeit auf eine bestimmte Strategie zurückgeführt werden können, da Experimente unter kontrollierten Bedingungen durchgeführt werden. Weiterhin ist es schwierig, bei eher kleinen Unterschieden zwischen zwei etablierten Verfahren, statistisch signifikante Ergebnisse zu erzielen, da die Teststärke dafür bei klinischen Therapiestudien dafür oftmals zu klein ist.

1.6.2 Akuter Schmerz

Zur Erforschung von spezifischen Einflussfaktoren chronischer Schmerzen ist es unumgänglich, auf die Induktion von akuten Schmerzen zurückzugreifen. Das Phänomen Schmerz kann im Labor auf verschiedene Weise erzeugt werden. Klassische Methoden bedienen sich der Erzeugung von Druckschmerzreizen, thermalen und elektrischen Schmerzreizen.

Eine Studie zeigte, dass sowohl die subjektiven Werte von Schmerztoleranz als auch derjenigen der Schmerzschwelle über verschiedene Arten von Schmerzinduktion korreliert waren (Harris & Rollman, 1983). Die Autoren diskutierten jedoch auch die bei Kälte und Druck fehlende Angstkomponente, welche die Generalisierbarkeit dieser Schmerzreize auf das klinische Setting zu limitieren scheint. Andere Studien zeigten, dass die Korrelationen zwischen verschiedenen Schmerzinduktionen bezüglich der Schmerzschwelle bei Fibromyalgiepatienten gering ausfielen (Lautenbacher, Rollman, & McCain, 1994). Die Autoren begründeten die Varianz durch die verschiedenen Arten von Nozizeptoren, die bei verschiedenen Induktionsarten für das Schmerzgeschehen verantwortlich sind. Weiterhin konnten nur schwache Zusammenhänge zwischen experimenteller Schmerzschwelle und klinischem Schmerz beobachtet werden. Eine neuere Studie bestätigte, dass die Empfindung von induziertem Hitzeschmerz nur unter hoher Intensität mit klinischem Schmerz zusammenhing. Schmerzschwellen und Schmerztoleranz bei Druckschmerz-induzierten Messungen hingegen wiesen auch bei geringen und mittleren Intensitäten Zusammenhänge mit klinischen Messungen auf (Geisser et al., 2007).

Schließlich ist die ökologische Validität der experimentellen Induktion von Schmerz eingeschränkt und stellt trotz dieser Einschränkungen ein notwendiges Mittel zur näheren Erforschung von Wirkweisen der verschiedenen therapeutischen Ansätze dar.

1.7 Emotionsregulations-Strategien im Kontext der Schmerzbewältigung

Aufgrund der theoretischen Ähnlichkeit zwischen der Entwicklung von chronischem Schmerz und einer Angsterkrankung ist anzunehmen, dass Emotionsregulations-Strategien für die Bewältigung von Schmerz relevant sind. Studien zeigten, dass die adäquate Anwendung von Emotionsregulations-Strategien mit Psychopathologie invers zusammenhängt (Aldao, Nolen-Hoeksema, & Schweizer, 2010). Wie bereits erwähnt, zeigen Therapiestudien, dass die zwei dargestellten Therapieformen effektiv sind. Werden die Therapieformen in ihre jeweiligen Bausteine zerlegt, finden sich insbesondere drei Emotionsregulations-Strategien, die von hervorstechender Bedeutung sein könnten.

Akzeptanz ist zwar ursprünglich keine Strategie zur Veränderung von Emotionen und doch wird sie häufig mit Emotionsregulations-Strategien verglichen oder selbst als eine Form der Emotionsregulation bezeichnet (Aldao et al., 2010; Dunn, Billotti, Murphy, & Dalgleish, 2009; Hofmann & Asmundson, 2008; Liverant, Brown, Barlow, & Roemer, 2008; Szasz, Szentagotai, & Hofmann, 2011). Akzeptanz soll die Verbindung zwischen Gedanken und Verhalten lösen, damit Patienten bereit sind, Schmerzen für längere Zeit zu ertragen und unabhängig von opponierenden Gedanken und Gefühlen werteorientierten Aktivitäten nachgehen.

Ablenkung ist eine Strategie, die den Fokus der Aufmerksamkeit vom Schmerz weglenken soll. Die Verlagerung des Aufmerksamkeitsfokus kann entweder auf andere externe oder interne Reize vollzogen werden. Innere Ablenkungen könnten durch angenehme Erinnerungen oder Bilder hervorgerufen werden. Äußere Ablenkung beruft sich auf die Fokussierung aktuell wahrnehmbarer Stimuli. Modellannahmen gehen von einer begrenzten Aufmerksamkeitskapazität aus, welches dazu führt, dass die Beschäftigung mit anderen Ereignissen zu einer schwächeren Wahrnehmung von Schmerz führt (Hodes, Rowland, Lightfoot, & Cleeland, 1990; McCaul & Malott, 1984).

Die **kognitive Umstrukturierung** dysfunktionaler schmerzbezogener Gedanken soll dazu führen, dass das schmerzbezogene Coping verbessert wird und Verhaltensweisen, die zu

Einschränkungen führen, vermieden werden. Schmerzbezogene Überzeugungen, Katastrophisierung und Selbstwirksamkeit stellten sich als die vermittelnden Variablen der Effekte von KVT auf Schmerz und Aktivität heraus (Turner, Holtzman, & Mancl, 2007). Die Autoren schlussfolgerten, dass insbesondere die Veränderung schmerzbezogener Überzeugungen den Therapieerfolg beeinflusst.
Abbildung 4 verdeutlicht die Ansatzpunkte der Strategien im Fear-Avoidance Modell.

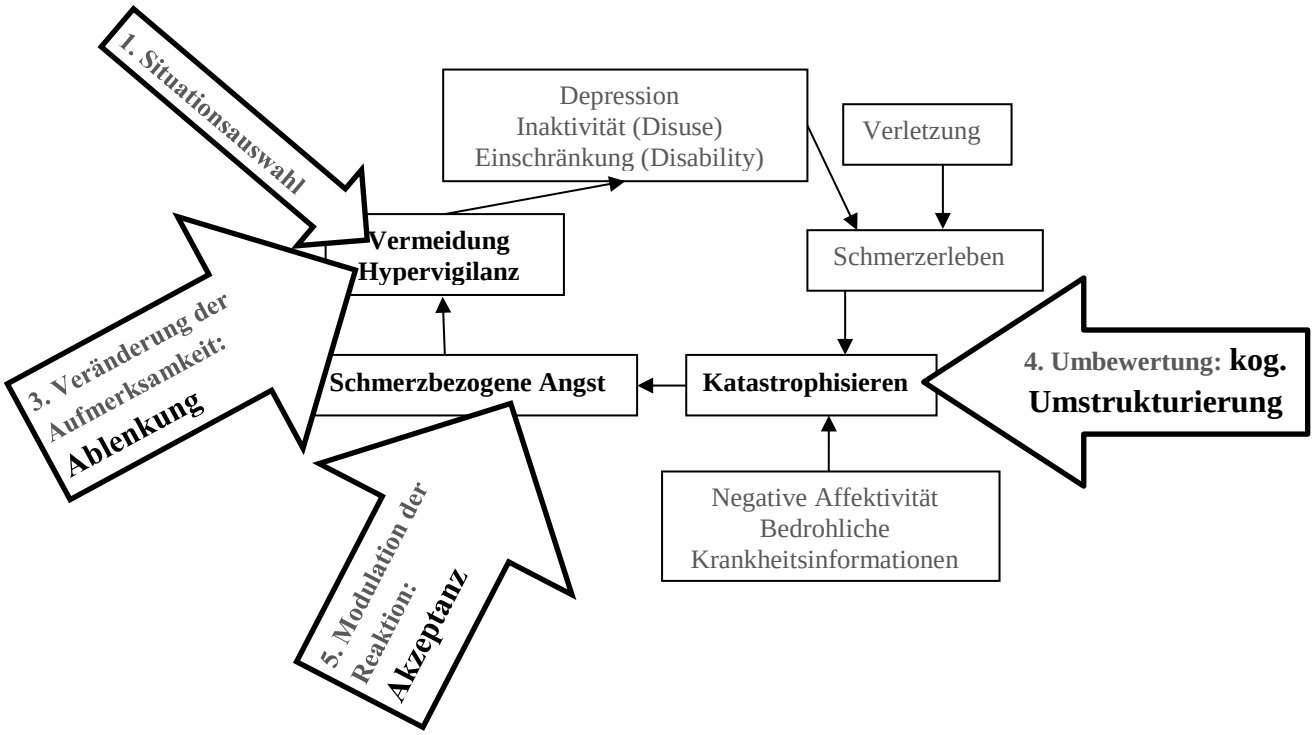

Abbildung 4: Emotionsregulations-Strategien im Kontext des Fear-Avoidance Modells (Vlaeyen & Linton, 2000, 2012)

Autoren einer Studie gruppierten potentiell adaptive Emotionsregulations-Strategien wie Akzeptanz, Umbewertung und Problemlösung und maladaptive Strategien wie Unterdrückung, Rumination oder Vermeidung zusammen (Aldao et al., 2010). Maladaptive Strategien waren mit Psychopathologie positiv korreliert, während adaptive Emotionsregulations-Strategien invers mit Psychopathologie zusammenhingen.
Sowohl akzeptanzbasierte Strategien als auch kognitiv-behaviorale Strategien können in das o.g. Modell der Emotionsregulation eingeordnet werden (Hofmann & Asmundson, 2008).

1.7.1 Vergleich der Wirksamkeit der verschiedenen Strategien

Die Mehrzahl der experimentellen Studien zeigte, dass Akzeptanz effektiver in der Erhöhung der Schmerztoleranz war als andere Strategien wie Ablenkung oder Unterdrückung

(Branstetter-Rost et al., 2009; Gutiérrez et al., 2004; Hayes, Bissett, et al., 1999; Masedo & Rosa Esteve, 2007; McMullen et al., 2008; Páez-Blarrina, Luciano, Gutiérrez-Martínez, Valdivia, Ortega, et al., 2008).

Manche Studien zeigten, dass Ablenkung oder Unterdrückung Schmerzintensität besser reduzierten als Akzeptanz (Branstetter-Rost et al., 2009; Gutiérrez et al., 2004; Páez-Blarrina, Luciano, Gutiérrez-Martínez, Valdivia, Ortega, et al., 2008).

Kognitive Umstrukturierung wurde selten isoliert untersucht. Kognitive Variablen scheinen jedoch die Schmerzintensität beeinflussen zu können (Ehde & Jensen, 2004; Flor & Turk, 1988).

2. Ziele der Dissertation

Die Lektüre von Studien ergab, dass in den letzten Jahren Akzeptanzstrategien in den Fokus der wissenschaftlichen Aufmerksamkeit gerückt waren, nachdem die Akzeptanz und Commitment Therapie durch positive Befunde zur Wirksamkeit des Verfahrens Aufsehen erregt hatte. Dabei stand die Frage im Raum, ob ACT ähnlich wie (oder sogar besser als) KVT chronischen Schmerz beeinflussen könnte. Randomisierte, kontrollierte Therapiestudien fehlten jedoch bislang und es schien hilfreich, zunächst einen Schritt zurück auf experimentelle Ebene zu treten, um die Wirksamkeit der einzelnen Bestandteile der Verfahren zu prüfen. Mehrere Autoren untersuchten, inwiefern Akzeptanzstrategien anderen Strategien wie Ablenkung oder Unterdrückung hinsichtlich Schmerztoleranz und –Intensität überlegen waren. In den Ergebnissen dieser Studien zeigten sich jedoch Widersprüche.

Daher bestand das erste Ziel dieser Dissertation darin, sich einen Überblick über die vorhandene Datenlage zur Effektivität von Akzeptanzstrategien im Experiment zu verschaffen und daraus offene Fragestellungen für weiterführende Untersuchungen zu generieren. Aufgrund der geringen Zahl von Untersuchungen bei Schmerz erweiterten wir den Fokus auch auf andere Zielvariablen wie z.B. negativer Affekt, bei denen Akzeptanz und andere Emotionsregulations-Strategien miteinander verglichen wurden.

Ausgehend von der meta-analytischen Übersichtsarbeit fiel ins Auge, dass die Ergebnisse vieler Studien, die Unterschiede zwischen den Strategien untersuchten, anhand sehr kleiner Stichproben gewonnen worden waren, und Studien zum Vergleich zwischen Akzeptanzstrategien und solchen zur kognitiven Umstrukturierung bei Schmerz bislang gänzlich fehlten. Das Fear-Avoidance Modell (Vlaeyen & Linton, 2000, 2012) geht davon aus, dass sowohl das Erleben von Schmerz als auch der Umgang mit Schmerz als Faktoren auf den Chronifizierungsprozess einwirken. Um sowohl Effekte auf das Erleben von Schmerz als auch auf das Schmerzverhalten zu untersuchen, wurden (auch in Anlehnung an frühere Paradigmen) als abhängige Variablen Schmerzintensität und Schmerztoleranz gewählt. Daher war das Ziel der zweiten Studie herauszufinden, ob die Instruktionen zu Akzeptanz, Ablenkung oder zur kognitiven Umstrukturierung differentielle Effekte auf die Variablen Schmerzintensität und Schmerztoleranz erzielen.

Die Generalisierbarkeit der Ergebnisse, die an gesunden Populationen gewonnen wurden, ist aufgrund der mäßigen Vergleichbarkeit zwischen akutem und chronischem Schmerz eingeschränkt. Studien zur Wirksamkeit psychologischer Therapien bei Fibromyalgiepatienten kamen jedoch zu widersprüchlichen Ergebnissen, ob diese Patientengruppe überhaupt auf solche Behandlungen ansprechen (Bernardy et al., 2010;

Glombiewski, Sawyer, et al., 2010). Zudem weisen Fibromyalgiepatienten Unterschiede im Schmerzerleben und -Verhalten sowohl im Vergleich zu Gesunden als auch im Vergleich zu anderen Schmerzpatienten auf. Durch diese Unterschiede lag nahe, dass potentielle Boden- und Deckeneffekte durch eine schmerzhafte Manipulation vermieden werden konnten. Zudem sind Schmerzzustände bei anderen chronischen Schmerzpatienten wie z.B. Rückenschmerzpatienten lokaler begrenzt als bei Fibromyalgiepatienten, weswegen eine Induktion von Schmerz am Unterarm für Fibromyalgiepatienten möglicherweise relevanter war als für chronische Rückenschmerzpatienten. Daher erschien es ratsam, im nächsten Schritt die gewonnen Befunde an einer klinischen Stichprobe von Fibromyalgiepatienten zu validieren.

2.1 Methoden

Innerhalb der ersten Studie wurde eine Literatursuche in Pubmed und PsychInfo durchgeführt, um infrage kommende Studien herauszufiltern. Im Vorfeld waren Einschlusskriterien bestimmt worden und dementsprechend Akzeptanzstrategien und andere Emotionsregulations-Strategien definiert worden. Zielvariablen wurden festgelegt. Die den Kriterien entsprechenden experimentellen Studien wurden gesichtet und einzelne Merkmale der Studien wie Stichprobengröße, Alter, Art der Kontrollgruppe, etc. beschrieben. Dann wurden die Ergebnisse zunächst systematisch deskriptiv beschrieben und hinsichtlich der zur Verfügung stehenden und für die Berechnung suffizienten Variablen wurden Ergebnisse meta-analytisch ausgewertet. Zur meta-analytischen Auswertung wurde sich des Programms Comprehensive Meta-Analysis in der zweiten Version (Borenstein, Hedges, Higgins, & Rothstein, 2005) bedient.

Die Methode der zweiten Studie basierte auf einem experimentellen Messwiederholungsdesign. Zunächst wurden die Probanden gebeten, im Vorfeld der Untersuchung via Unipark Fragebögen zu habituellen Copingstrategien, Depression, Schmerzsensitivität und Schmerzkatastrophisierung auszufüllen. Zwei weibliche Versuchsleiterinnen führten den Versuch durch. Bei gesunden Studentinnen wurden Hitze- und Kältereize zwischen 0 und 50°C mithilfe einer 3x3 cm großen Thermode (TSA II: Thermal Sensory Analyzer, Medoc Ltd, Israel) am dominanten Unterarm appliziert. Zunächst konnten sich die Probandinnen mit der Apparatur vertraut machen. Dann wurden die Reize in auf- und absteigender Sequenz appliziert, wobei die Probanden gebeten wurden, die Reize so lange wie möglich auszuhalten und am Ende jedes Durchgangs die Intensität des Schmerzes auf einer visuellen Analogskala zu beurteilen. Die Reize konnten mithilfe eines Mausclicks

jederzeit beendet werden. Die Schmerztoleranz wurde durch die Temperatur, bei der die Probandinnen den Reiz beendeten, operationalisiert. Nach dem ersten Durchgang wurde durch ein randomisiertes Vorgehen, eine von drei Instruktionen (Akzeptanz, Ablenkung, kognitive Umstrukturierung) dargeboten. Die Instruktionen wurden unter Berücksichtigung experimenteller Vorarbeiten und deren Ergebnisse zusammengestellt. Die Instruktionen dauerten alle ca. 5 Minuten, wurden über Kopfhörer dargeboten und waren in ähnlicher Weise strukturiert. Im Anschluss an die Instruktionen erfolgte eine erneute Applikation der Schmerzreize und die Erhebung o.g. Variablen. Am Ende des Experimentes erfolgte eine Überprüfung der Manipulation. Dabei wurden die Probandinnen gebeten einzuschätzen, wie glaubhaft sie die Instruktionen fanden und wie gut sie diese angewendet hatten.

Das zweite Experiment gestaltete sich im Aufbau ähnlich wie das Vorgänger-Experiment. Anstelle von gesunden Studentinnen wurden Fibromyalgiepatienten getestet. Patienten füllten ebenfalls mithilfe von Unipark im Vorfeld der Untersuchung Fragebögen aus, die habituelle Copingstrategien bei Schmerzpatienten erfassen. Außerdem wurde das Ausmaß an Depression und Schmerzsensitivität erhoben. Der Aufbau des Messwiederholungsdesigns (Pretest, Instruktion, Posttest) gestaltete sich wie zuvor beschrieben. Im Unterschied zum Vorgänger-Experiment setzten wir Hitze- und Kältereize ein, die jeweils an den Maxima über 30 Sekunden gehalten wurden, so sie nicht vorher von den Patienten beendet wurden. Mithilfe dieses Vorgehens konnte der Schmerzreiz für eine längere Zeit aufrechterhalten werden, ohne den Probanden zu schädigen und um Boden- und Deckeneffekte zu minimieren. Anders als beim Vorgänger-Experiment wurde die Schmerztoleranz über die Zeit, die die Probanden den Schmerz ertrugen, operationalisiert. Die Erfassung von Schmerzintensität erfolgte wie oben beschrieben. Um auszuschließen, dass Ergebnisse durch Habituationseffekte entstanden sein könnten, wurde die Ablenkungsinstruktion durch eine Kontrollinstruktion ersetzt. Die anderen beiden Instruktionen zur Akzeptanz und zur kognitiven Umstrukturierung wurden um Metaphern ergänzt und auf das chronische Erleben von Schmerz adaptiert. Unmittelbar nach der Darbietung der Instruktion sollten die Teilnehmer die Glaubwürdigkeit und Erwartung bezüglich der erhaltenen Instruktion einschätzen und eine Zusammenfassung des Gehörten notieren. Nach der zweiten Applikation von Schmerzreizen erfolgte eine weitere Überprüfung der Manipulation mithilfe der Selbsteinschätzung zu wie viel Prozent Instruktionen angewendet worden waren. Schließlich wurde das subjektive Ausmaß der Veränderung von Schmerztoleranz und Schmerzintensität erfragt.

3. Zusammenfassung der Studien

3.1 Zusammenfassung Studie 1

Kohl, A., Rief, W., & Glombiewski, J.A. (2012). **How effective are acceptance strategies? A meta-analytic review of experimental results.** *Journal of Behavior Therapy and Experimental Psychiatry, 43(*4), 988-1001.

3.1.1 Hintergrund und Zielsetzung

Akzeptanzbasierte Strategien erfreuen sich größerer Beliebtheit, seitdem die Akzeptanz- und Commitment Therapie als psychologische Intervention ins wissenschaftliche Interesse gerückt ist. Auch in der experimentellen Forschung wurden akzeptanzbasierte Strategien mit anderen Emotionsregulations-Strategien in Bezug auf verschiedene abhängige Variablen untersucht. Es zeigten sich widersprüchliche Ergebnisse in Bezug auf die Überlegenheit von akzeptanzbasierten Strategien gegenüber anderen Emotionsregulations-Strategien wie Unterdrückung, Ablenkung oder Umbewertung.

Diese bisher erste meta-analytische Übersichtsarbeit soll prüfen, ob akzeptanzbasierte Strategien anderen Emotionsregulations-Strategien vorgezogen werden sollten. Dabei soll auch beleuchtet werden, in wie weit sich eine mögliche Überlegenheit nur auf bestimmte abhängige Variablen beschränkt und ob mögliche Unterschiede durch die Verschiedenheit von akzeptanzbasierten Strategien, deren Vergleichsgruppe oder durch die Stichprobenzusammensetzung erklärt werden können.

3.1.2 Methode

Mithilfe der elektronischen Suche in den Datenbanken PsychInfo und PubMed wurden die Studien auf ihre Eignung für die vorliegende Untersuchung hin geprüft. Dabei wurden Studien ausgewählt, die verschiedene Arten von akzeptanzbasierten Strategien in einem experimentellen Design untersuchten. Akzeptanzbasierte Strategien konnten in ihrem Inhalt mehr durch einen ACT-Perspektive gekennzeichnet werden, sich v. a. auf Achtsamkeit stützen oder aus einer Emotionsregulations-Perspektive heraus entstanden sein. Strategien wie Ablenkung, Umbewertung oder Unterdrückung, die aus einem Emotionsregulations-Hintergrund stammten wurden ebenso als Kontrollstrategien eingeschlossen wie solche, die gemäß ACT als kontrollbasierte Strategien benannt werden.

Im meta-analytischen Teil der Arbeit wurden Hedge’s g Effektstärken berechnet, die sich auf die Unterschiede zwischen den Gruppen bezogen.

3.1.3 Ergebnisse

30 Studien waren für die vorliegende Untersuchung relevant. Viele Studien berichteten, dass akzeptanzbasierte Strategien anderen Emotionsregulations-Strategien in Bezug auf die abhängigen Variablen Schmerztoleranz, negativer Affekt und Glaubwürdigkeit von Gedanken überlegen waren. Meta-analytisch konnte allerdings nur für Schmerztoleranz statistisch die Überlegenheit von akzeptanzbasierten Strategien gesichert werden. Die Effektstärke zwischen den Gruppen war klein bis moderat ausgeprägt (g = 0.43, p < 0.01, 95% Konfidenzintervall [0.12, 0.73]). Hinsichtlich der abhängigen Variablen Schmerzintensität und negativem Affekt zeigte die meta-analytische Berechnung keine Unterschiede zwischen den Gruppen. Somit konnte keine generelle Überlegenheit akzeptanzbasierter Strategien festgestellt werden. In Bezug auf die abhängige Variablen Schmerztoleranz schien die Art und Weise, wie die akzeptanzbasierte Strategie erklärt und angewendet wurde, einen wichtigen Einfluss zu nehmen. Außerdem zeigte sich, dass akzeptanzbasierte Strategien insbesondere maladaptiven Emotionsregulations-Strategien wie Unterdrückung und Rumination überlegen sind.

3.1.4 Diskussion

Schlussfolgernd lässt sich feststellen, dass die Anwendung von akzeptanzbasierten Strategien in der Behandlung von Schmerz und Depression mindestens so effektiv ist wie der Einsatz anderer Emotionsregulations-Sstrategien. Nachfolgende Studien sollten untersuchen, welche Prädiktoren (Patientenmerkmale) den Anwendungserfolg der verschiedenen Strategien bestmöglich vorhersagen. Es fehlen weitere experimentelle Untersuchungen bezüglich des Vergleichs zwischen akzeptanzbasierten Strategien und solchen, die eine Umbewertung nahelegen. Schließlich sollten die verschiedenen Strategien in Patientenstichproben getestet werden.

3.2 Zusammenfassung Studie 2

Kohl, A., Rief, W., & Glombiewski, J. A. (submitted). **Acceptance, cognitive restructuring, and distraction as coping strategies for acute pain.**

3.2.1 Hintergrund und Zielsetzung

Die vorangestellte Untersuchung belegt die Wirksamkeit akzeptanzbasierter Strategien bei akutem Schmerz. Im experimentellen Setting wurden akzeptanzbasierte Strategien bisher nur mit Ablenkungs- oder Unterdrückungsstrategien bei akutem Schmerz untersucht. Keine Studie verglich bislang experimentelle Akzeptanzstrategien mit Strategien zur kognitiven

Umbewertung, die kognitiv-behavioralen Verfahren bei chronischem Schmerz häufig Verwendung finden.

Diese Untersuchung soll mithilfe eines experimentellen Designs herausfinden, ob Unterschiede zwischen Akzeptanzstrategien und solchen zur kognitiven Umstrukturierung oder Ablenkung hinsichtlich der Beeinflussung von Schmerztoleranz und Schmerzintensität bestehen.

3.2.2 Methode

109 Studentinnen wurden randomisiert einer der drei Instruktionen (Akzeptanz, Ablenkung, kognitive Umstrukturierung) zugeteilt und einer Schmerzinduktion unterzogen. Hitzeschmerz wurde mithilfe einer Thermode vor und nach einer der drei Instruktionen induziert. Dabei wurde die Schmerztoleranz jeweils über die Temperatur bei Abbruch des Hitzereizes operationalisiert. Das Ausmaß der Schmerzintensität wurde jeweils von den Probandinnen auf einer visuellen Analogskala beurteilt.

Die statistische Berechnung erfolgte mithilfe zweier Kovarianzanalysen, bei denen als abhängige Variablen Schmerztoleranz oder die Schmerzintensität zum zweiten Messzeitpunkt und als unabhängige Variablen die drei Instruktionen eingingen. Der erste Messzeitpunkt der Variablen wurde jeweils als Kovariate eingesetzt und somit statistisch kontrolliert. Weiterhin wurden die Variablen Instruktionsanwendung und Glaubwürdigkeit als Kovariaten aufgenommen.

3.2.3 Ergebnisse

Es zeigte sich ein Haupteffekt der Instruktionsbedingung auf Schmerztoleranz [$F(2,99) = 3.2$, $p < 0.05$, *partielles* $\eta^2 = 0.061$]. Die Akzeptanzstrategie führte zu einer höheren Schmerztoleranz als die Instruktion zur kognitiven Umstrukturierung schmerzbezogener Gedanken ($p < 0.05$). Es fanden sich keine signifikanten Unterschiede in der Schmerztoleranz zwischen Akzeptanzstrategien und solchen zur Ablenkung sowie zwischen Ablenkung und kognitiver Umstrukturierung. Zudem ergab sich ein signifikanter Einfluss der Kovariate Glaubwürdigkeit der Instruktion auf das Ausmaß der Schmerztoleranz. Die Instruktionsbedingung verzeichnete einen Haupteffekt auf Schmerzintensität [$F(2,103) = 3.97$, $p < 0.05$, *partielles* $\eta^2 = 0.072$]. Es zeigte sich, dass Ablenkung zu einer geringeren Ausprägung an Schmerzintensität führte als Akzeptanz ($p < 0.01$). Darüber hinaus wendeten die Probandinnen die Ablenkungsstrategie in größerem Maß an, als sie Akzeptanz oder kognitive Umstrukturierung einsetzten.

3.2.4 Diskussion

In Anbetracht der Ergebnisse ist die gezielte Anwendung von Strategien je nach Zielvariable angebracht. So scheinen akzeptanzbasierte Interventionen insbesondere auf verhaltensnahe Variablen einzuwirken, während ablenkungsbasierte Instruktionen eher das Schmerzerleben zu beeinflussen. Zudem fällt es den Versuchspersonen leichter, Ablenkungsstrategien einzusetzen, weil sie diese eher anwenden. Der Einfluss von Schmerzkatastrophisierung auf die Ergebnisse der kognitiven Umstrukturierungsinstruktion wird diskutiert. Weitere Studien sind wichtig, um die Generalisierbarkeit der Ergebnisse auf männliche Populationen und auf chronische Schmerzpatienten zu gewährleisten. Außerdem stellt sich weiterhin die Frage, welche Probandenmerkmale das Ansprechen auf die verschiedenen Instruktionen moderieren. Darüber hinaus scheint auch die Art und Weise, wie glaubhaft eine Instruktion vermittelt wird, einen wichtigen Beitrag zur Beeinflussung verhaltensnaher Variablen zu leisten.

3.3 Zusammenfassung Studie 3

Kohl, A., Rief, W., & Glombiewski, J. A. (submitted). **Do fibromyalgia patients benefit from cognitive restructuring and acceptance? An experimental study.**

3.3.1 Hintergrund und Zielsetzung

Studien zur Wirksamkeit psychologischer Therapien bei Fibromyalgie ergaben unterschiedliche Ergebnisse. Die vorangehenden Studien zu experimentell induziertem Schmerz bei Gesunden zeigten, dass akzeptanzbasierte Strategien die experimentelle Schmerztoleranz stärker erhöhen als Strategien, die auf eine kognitive Umstrukturierung schmerzbezogener Gedanken abzielen. Dieser Unterschied konnte für die Schmerzintensität nicht bestätigt werden.

Da sich chronische Schmerzpatienten von gesunden Probanden in verschiedenen Charakteristika, die für die Untersuchung von akutem Schmerz relevant sind, unterscheiden, ist die Generalisierbarkeit bisheriger Arbeiten eingeschränkt. Insbesondere Fibromyalgiepatienten scheinen im Vergleich zu anderen chronischen Schmerzpatienten Veränderungen in der Schmerztoleranz und in der Schmerzvigilanz aufzuweisen. Eine erhöhte Schmerzsensitivität scheint zudem ein erhöhtes Risiko darzustellen, von Behandlungen weniger zu profitieren.

Daher soll nun untersucht werden, welche Effekte kognitive Umstrukturierung und Akzeptanz als experimentelle Strategien auf die Schmerztoleranz und –Intensität bei

Fibromyalgiepatienten erzielen und ob die Schmerzsensitivität Einfluss auf die Ergebnisse nimmt.

3.3.2 Methode

60 Fibromyalgiepatienten wurden randomisiert einer von drei Bedingungen zugeteilt (Akzeptanz, kognitive Umstrukturierung und Kontrollbedingung (KG)). Den Patienten wurde mithilfe einer Thermode Hitze- und Kälteschmerz vor und nach der entsprechenden Instruktion zugefügt. Dabei diente die Zeit, wie lange sie die Reize jeweils aushielten, als abhängige Variable (Schmerztoleranz). Zu beiden Messzeitpunkten wurde über eine visuelle Analogskala das Ausmaß der Schmerzintensität erfasst.

Die statistische Auswertung erfolgte durch Kovarianzanalysen, jeweils für Hitze- und Kältestimuli wie auch für Schmerztoleranz und –Intensität getrennt. Die Daten zum ersten Messzeitpunkt flossen als Kovariaten in die Analyse ein. Weiterhin wurde für Alter, Depression und Schmerzsensitivität kontrolliert. Schließlich erfolgten Responder-Analysen, um das Ansprechen auf die verschiedenen Instruktionen zu ergründen.

3.3.3 Ergebnisse

Es zeigte sich ein Haupteffekt für Instruktionsbedingung auf Hitzeschmerztoleranz [$F(2, 53) = 4.41$, $p < 0.05$, *partielles* $\eta^2 = 0.145$]. Sowohl akzeptanzbasierte Strategien als auch solche zur kognitiven Umstrukturierung erhöhten die Hitzeschmerztoleranz in signifikant stärkerem Maße als die Kontrollbedingung *(*$p < 0.01$für kognitive Umstrukturierung vs. KG und $p< 0.05$ für Akzeptanz vs. KG). Zwischen den beiden Strategien zeigten sich jedoch keine Unterschiede. Hinsichtlich der Kälteschmerztoleranz ergab sich ebenfalls ein signifikanter Haupteffekt der Instruktionsbedingung [$F(2, 36) = 3.8$, $p < 0.05$, *partielles* $\eta^2 = 0.11$]. Es zeigte sich nur die Strategie zur kognitiven Umstrukturierung gegenüber der Kontrollbedingung als signifikant überlegen ($p < 0.01$). Die Schmerzintensität zeigte sich für beide Reizmodalitäten nicht signifikant verschieden bezüglich der drei Bedingungen [$F(2,53) = 2.2$, $p = 0.121$ für Hitzeschmerzintensität; $F(2,53) = 3.1$, $p = 0.53$ für Kälteschmerzintensität]. Allerdings führte sowohl Akzeptanz als auch kognitive Umstrukturierung bei bis zu 30% der Probanden zu einer Reduktion der Schmerzintensität um mindestens 30%, wohingegen kein Proband aus der Kontrollbedingung die Schmerzintensität um 30% zu reduzieren vermochte.

Explorative Analysen ergaben, dass in der Gruppe der kognitiven Umstrukturierung die Hitzeschmerztoleranz signifikant mit der Schmerzsensitivität korreliert war.

3.3.4 Diskussion

Die Studie belegt die Wirksamkeit von akzeptanzbasierten Strategien sowie von Strategien zur kognitiven Umstrukturierung, thermische Reizen in einer Stichprobe von Fibromyalgiepatienten länger zu tolerieren. Obwohl sich inferenzstatistisch keine Unterschiede zwischen den Strategien bezüglich der Schmerzintensität zeigten, legten Responder-Analysen die Vermutung nahe, dass Patienten von Akzeptanz und kognitiver Umstrukturierung besser profitierten, als wenn sie keine Instruktion erhielten. Generell belegt die Studie, dass auch Fibromyalgiepatienten von psychologischen Strategien profitieren. Untersuchungen zeigen die Heterogenität des Störungsbildes. Weitere Forschung ist nötig, um die Ergebnisse zu replizieren und Prädiktoren für den Erfolg bestimmter Strategien wie z.B. Schmerzsensitivität ausfindig zu machen. Somit könnte eine ökonomische Anwendung zweier potentiell wirksamen Strategien gewährleistet werden.

4. Abschließende Diskussion

Akzeptanzbasierte Strategien scheinen nicht generell anderen Emotionsregulations-Strategien überlegen zu sein. Verglichen mit so genannten maladaptiven Emotionsregulations-Strategien zeigte sich jedoch eine Überlegenheit von Akzeptanz. Akzeptanzbasierte Strategien wirken sich zudem positiv auf Verhaltensveränderungen (Erhöhung von Schmerztoleranz) und auf die Glaubwürdigkeit von Gedanken aus. Variablen, die sich auf die Wahrnehmung bestimmter Reize beziehen (Schmerzintensität), scheinen in ähnlicher Weise wie andere Emotionsregulations-Strategien durch Akzeptanz zu beeinflussen zu sein. Einige Hinweise sprechen dafür, dass die Ausgestaltung der Akzeptanzinstruktion die Wirkweise ebensolcher beeinflusst (Branstetter-Rost et al., 2009; Páez-Blarrina, Luciano, Gutiérrez-Martínez, Valdivia, Ortega, et al., 2008; Szasz et al., 2011).

Ergebnisse zur Schmerztoleranz bei Gesunden ergaben, dass Akzeptanz die Schmerztoleranz signifikant stärker erhöhte als kognitive Umstrukturierung. Ablenkung hingegen führte zu einer geringeren Schmerzintensität als Akzeptanz.

Bei Fibromyalgiepatienten zeigte sich, dass sie bezüglich der Schmerztoleranz bei Hitzereizen sowohl von Akzeptanz als auch von kognitiver Umstrukturierung profitierten, wohingegen eine Kontrollbedingung beiden Interventionen unterlegen war. Bezüglich der Schmerzintensität erreichten bis zu 30% der Probanden in den aktiven Bedingungen (Akzeptanz, kognitive Umstrukturierung) eine Reduktion der Intensität um mindestens 30%, wohin gegen 0% der Kontrollgruppe eine solche Reduktion erzielte. Mit Hilfe der kovarianz-analytischen Auswertungsverfahren fanden sich hingegen keine signifikanten Unterschiede zwischen den Gruppen.

Verschiedene Untersuchungen legten nahe, dass Akzeptanz nur unter bestimmten Bedingungen, z.B. bei Stimuli, die für die Probanden hoch relevant oder besonders unangenehm waren, das Wirkspektrum ausbreitet (Forman et al., 2007; Gutiérrez et al., 2004; Páez-Blarrina, Luciano, Gutiérrez-Martínez, Valdivia, Ortega, et al., 2008). Es könnte daher sein, dass der akut ausgelöste Schmerz für Fibromyalgiepatienten nicht ausreichend bedrohlich war, damit Akzeptanzstrategien besser greifen konnten.

4.1 Einschränkungen

Es gibt eine geringe Zahl an Studien, die sich mit den spezifischen Wirkweisen der einzelnen Strategien beschäftigt. Für Verwirrung sorgen zudem der oft unterschiedliche Gebrauch und die breite Auslegung des Akzeptanzkonzeptes. Verschiedene Induktionsmethoden könnten weiterhin die Varianz innerhalb der Ergebnisse erhöhen. Die vielfache Untersuchung von

Strategien in gesunden Populationen bringt eine eingeschränkte Generalisierbarkeit der Ergebnisse mit sich. So bleibt beispielsweise unklar, ob im Verlaufe des Chronifizierungsprozesses andere Strategien wirkungsvoll sind. Auch die Auswirkung verschiedener Strategien im zeitlichen Verlauf einer Emotion oder des Schmerzgeschehens findet in vielen Studien nicht ausreichend Berücksichtigung.

Die Generalisierbarkeit auf eine breitere Alterskohorte bei Gesunden ist eingeschränkt. Die Strategien wurden innerhalb einer kurzen experimentellen Manipulation dargeboten. Der Spagat zwischen der gezielten Untersuchung von zugrunde liegenden Mechanismen und dem Anspruch an Vollständigkeit einzelner Merkmale einer Instruktion wird v.a. bei einer komplexen Instruktion wie kognitiver Umstrukturierung deutlich. Ein weiterer Kompromiss betrifft die Ausdehnung von Schmerzreizen, um das Experiment einerseits möglichst ökologisch valide zu machen und andererseits ethische Gesichtspunkte nicht zu verletzen. Weiterhin können die Ergebnisse nicht ohne weiteres auf männliche Populationen übertragen werden.

4.2 Weiterführende Forschung

Trotz der vielfältigen Befunde fehlen Studien, die untersuchen unter welchen personen- und situationsspezifischen Voraussetzungen welche Strategien am besten funktionieren. Die Untersuchung von Strategien im sequentiellen Verlauf des Schmerzgeschehens oder der Emotionsregulation sollte untersucht werden. Eingeschränkt ist nach wie vor die Forschungslage zu kognitiver Umstrukturierung. In Anbetracht der anzunehmenden Wichtigkeit auch für die Selektion von nachfolgenden Strategien auf einer metakognitiven Ebene ist es besonders verwunderlich, dass den Mechanismen kognitiver Interventionen so wenig Beachtung gezollt wurde.

4.3 Vorzüge der Arbeit

Die meta-analytische Übersichtsarbeit konnte verschiedene Befunde bezüglich unterschiedlicher Variablen integrieren und statistisch absichern. In den zwei experimentellen Untersuchungen wurde ein hoch standardisiertes Vorgehen zur Schmerzinduktion gewählt. Der angestellte Vergleich zwischen Akzeptanzstrategien und solchen zur kognitiven Umstrukturierung bei Schmerz wurde in bisherigen Untersuchungen nie beleuchtet. Die Strichprobengrößen waren ausreichend, um auch mittlere Effekte zu entdecken und statistisch abzusichern. Variablen, die möglicherweise die Anwendung der Strategien hätten

beeinflussen können, wurden im Vorfeld mit erhoben und die Anwendung und Glaubwürdigkeit der Instruktionen wurden ebenfalls erfasst.

Die Auswahl einer Fibromyalgie-Stichprobe zur Untersuchung der Strategien kann durch die besonderen Kennzeichen dieser Patientengruppe als großer Vorzug gewertet werden. Gerade für Patienten, die am ganzen Körper Schmerzen empfinden, scheint eine lokale Anwendung von Schmerzreizen relevanter als für Rückenschmerzpatienten.

4.4 Klinische Implikationen

Die klinischen Implikationen sind in Abbildung 5 dargestellt. Für chronische Schmerzpatienten ist das Aushalten des Schmerzes ein wichtiges Verhalten, das sowohl dem Patienten selbst als auch der Gesellschaft zu nutzen kommt. Die Vermeidung von Schmerzen führt zu Einschränkungen im Lebensalltag sowie zu hohen arbeitsbezogenen Fehlzeiten. Aus den in der Dissertation überprüften Studien geht hervor, dass Gesunde am besten von Akzeptanz profitieren, um Schmerzen länger auszuhalten. Bei Fibromyalgiepatienten scheinen sowohl Akzeptanzstrategien als auch solche zur kognitiven Umstrukturierung gleichermaßen wirkungsvoll, um die Schmerztoleranz zu erhöhen. Die Fähigkeit, Schmerzen länger auszuhalten wird sicherlich auch durch die Kontrollierbarkeit der Schmerzintensität mit bestimmt. Hinsichtlich der Schmerzintensität ergeben sich Hinweise für die Bedeutsamkeit der Anwendung von Ablenkungsstrategien bei Gesunden. Bei Fibromyalgiepatienten scheint sich die Schmerzintensität generell schwerer beeinflussen zu lassen, als dass Unterschiede zwischen Bedingungen ein signifikantes Niveau erreichen würden. Trotzdem erlangten nur Patienten aus den aktiven Strategiebedingungen (Akzeptanz und kognitive Umstrukturierung) eine 30%-ige Reduktion der Schmerzintensität. Daher scheint die Anwendung dieser aktiven Strategien besser zu sein, als den Patienten keine Strategien im Umgang mit Schmerzintensität an die Hand zu geben. Schließlich sollten Patienten alle drei Strategien vermittelt werden, da sie potentiell von allen Strategien profitieren können und schädliche Effekte nicht zu erwarten sind.

In der Erlernung der verschiedenen Strategien scheinen die Glaubwürdigkeit wie die Anwendungsbereitschaft wichtige Faktoren für das Gelingen der Strategie zu sein.

Geht man von der Integration des Fear-Avoidance Modells (Vlaeyen & Linton, 2000, 2012) in das Emotionsregulations-Modell (Gross, 1998, 2002) aus (siehe Abbildungen 3 bis 5), so könnte man annehmen, dass die Bewertung der Schmerzgeschehens relevant für Antezedenz-fokussierte Strategien als auch für Response-fokussierte Strategien ist. Auf *inhaltlicher Ebene* kann kognitiv diskutiert werden, ob sich ein Gedanke auf vorhergehende Erfahrungen gründet

(„mein Schmerz deutet auf eine ernstzunehmende Schädigung hin“), gemäß der Situation realistisch („wenn ich mich jetzt falsch bewege, bricht meine Wirbelsäule“) oder hilfreich („zu welcher Konsequenz führt es, wenn ich dem Schmerz folge“) ist. Auf einer *meta-kognitiven Ebene* könnte die Bewertung der Situation jedoch auch die Response-fokussierte Modulation beeinflussen. In dieser Phase müsste gemäß ACT eine Bewertung erfolgen i. S. „führt dieser Gedanke zu einer werteorientierten Handlung?“. Somit könnte man annehmen, dass auch dem Akzeptanz-Prozess eine Bewertung vorausgeht, die prüft, ob dem Gedanken Aufmerksamkeit geschenkt wird. Im Grunde genommen könnte man auch einen Entscheidungsprozess für die Wahl einer Ablenkungsstrategie annehmen: „Ist die innere Empfindung (Schmerz) gefährlich oder kann ich meine Aufmerksamkeit auf eine andere Wahrnehmung lenken?“

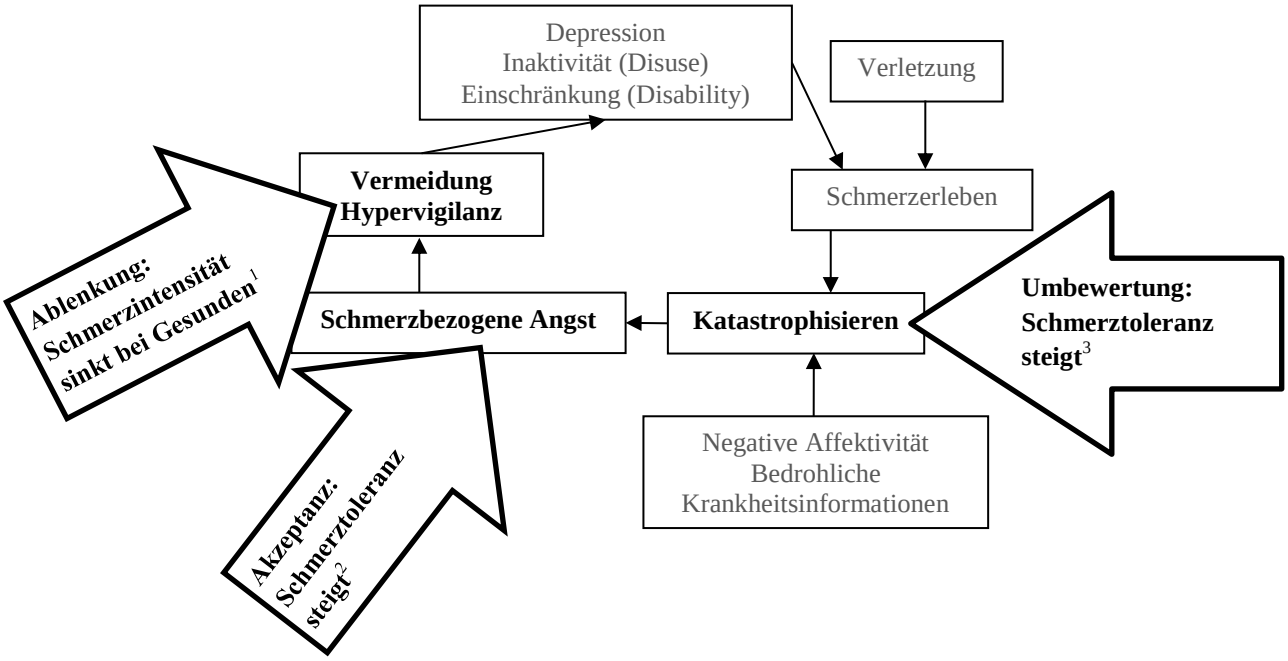

Abbildung 5: Wirksamkeit der einzelnen Strategien im Kontext des Fear-Avoidance Modells (Vlaeyen & Linton, 2000, 2012). Anmerkungen: [1] siehe Studie 2, [2] siehe Studien 1 bis 3, [3] siehe Studie 3

So könnte man sagen, dass alle drei Herangehensweisen ähnliche Ziele verfolgen – nämlich aus der Aufrechterhaltung des Schmerzgeschehens auszusteigen – die auf unterschiedlichen Wegen erreicht werden. Dabei sollte die Anwendung von der einen oder anderen wirksamen Strategie möglicherweise auch auf die Interessen und Merkmale des Patienten abgestimmt sein.

5. Fazit

Akzeptanzbasierte Strategien zur Erhöhung der Schmerztoleranz scheinen gegenüber anderen Emotionsregulations-Strategien wie Ablenkung und kognitiver Umstrukturierung insbesondere bei gesunden Probanden überlegen zu sein. Bei Fibromyalgiepatienten sind Strategien zur kognitiven Umstrukturierung mindestens genauso wirksam.

Bei gesunden Probanden scheint Ablenkung gleichwohl eine gute Methode zu sein, um Schmerzen weniger stark zu spüren. Bei Fibromyalgiepatienten gestaltet sich die Beeinflussung der Schmerzintensität zwar schwieriger, aber durch kognitive Umstrukturierung und Akzeptanz nicht unmöglich.

Eine Integration der Therapieformen ACT und KVT scheint daher für die Bewältigung chronischer Schmerzen sinnvoll.

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Appendix

A: 1.Studie

B: 2. Studie

C: 3. Studie

D: Curriculum Vitae und Publikationsliste

E: Eidesstattliche Erklärung

A: 1. Studie

Kohl, A., Rief, W., & Glombiewski, J.A. (2012). **How effective are acceptance strategies? A meta-analytic review of experimental results.** *Journal of Behavior Therapy and Experimental Psychiatry*, *43(*4), 988-1001.

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How effective are acceptance strategies? A meta-analytic review of experimental results

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ABSTRACT

Background and objectives: Experimental research on psychological acceptance strategies revealed discrepant results regarding superiority of these strategies compared to other emotion regulation strategies. A review examining results of experimental comparisons between acceptance and other emotion regulation strategies (e.g. suppression, distraction, reappraisal) is still missing. The present meta-analytic approach aims to fill this gap.
Method: A literature search was performed using PsychInfo and PubMed and effect sizes (ES; Hedge's *g*) were calculated.
Results: The search identified 30 relevant studies. Many studies reported that acceptance strategies were superior when compared to other emotion regulation strategies for the outcomes of pain tolerance, negative affect and believability of thoughts. Meta-analytic results replicate findings of primary studies for pain tolerance: A small to medium between-group ES was found favoring acceptance strategies ($g = 0.43$, $p < 0.01$, 95% CI[0.12, 0.73]). With respect to pain intensity and negative affect, meta-analysis did not show any significant differences between acceptance and other emotion regulation strategies. In sum, acceptance strategies proved to be superior to other emotion regulation strategies with respect to pain tolerance but not for pain intensity and negative affect.
Limitations: Future research should address which characteristics of participants lead to respond to either acceptance or to other emotion regulation strategies.
Conclusions: Acceptance strategies are at least as useful in treatments for chronic pain and depression as other emotion regulation strategies.

1. Introduction

1.1. Acceptance strategies in psychological research

Acceptance is a psychological strategy that has seen increased popularity since a growing body of research has focused on Acceptance and Commitment Therapy (ACT), a psychological intervention developed by Hayes, Strohsal and Wilson in the 1990s (Hayes, Strohsal, & Wilson, 1999). This approach belongs to the so-called "third wave of cognitive behavior therapy" (Hayes, Masuda, Bissett, Luoma, & Guerrero, 2005). Acceptance has also been a concept within Cognitive Behavior Therapy (CBT), but the founders of ACT elaborated acceptance in depth (as one of other components such as defusion, mindfulness etc.). The ACT model describes acceptance as the willingness to take in an event or situation (Hayes, Bissett et al., 1999). Although acceptance is not a strategy that is meant to change emotions, it is often compared to strategies that aim at regulating emotions such as suppression, distraction or reappraisal. Some authors label acceptance as an emotion regulation strategy (Aldao, Nolen-Hoeksema, & Schweizer, 2010; Dunn, Billotti, Murphy, & Dalgleish, 2009; Hofmann & Asmundson, 2008; Liverant, Brown, Barlow, & Roemer, 2008; Szasz, Szentagotai, & Hofmann, 2011). A variety of reviews and a meta-analysis proved the efficacy of ACT and reported moderate effect sizes (ES) (Hayes et al., 2005; Oest, 2008; Powers, Vording, & Emmelkamp, 2009; Pull, 2009), but ACT does not seem to be superior to established treatments such as CBT (Gaudiano, 2009).

The aim of the present study is to investigate if acceptance strategies should be favored over other strategies, which can be summarized under the heading 'emotion regulation strategies'.

1.2. Experimental research on acceptance strategies

Results of experimental comparisons between acceptance strategies and other emotion regulation strategies regarding short

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term effects are contradictory. Some studies found that acceptance strategies were superior to other emotion regulation strategies (Hayes, Bissett et al., 1999; Masuda et al., 2010), while other studies did not (Hofmann, Heering, Sawyer, & Asnaani, 2009; Westin, Ostergren, & Andersson, 2008).

1.3. Four major problems of experimental research on acceptance strategies

Firstly, the results of the comparison between acceptance strategies and other emotion regulation strategies vary according to outcome measures. For instance, within one study, the acceptance strategy proved to be more effective than the other emotion regulation strategy in reducing anxiety but not in decreasing panic symptoms (Levitt, Brown, Orsillo, & Barlow, 2004). Thus, acceptance strategies may be superior to other emotion regulation strategies, but only for some outcome measures.

Secondly, experimental studies on acceptance strategies sometimes mix up the diverse components of ACT and merge them together under the heading of acceptance. Therefore, little is known about the efficacy of each of the components that were labeled as acceptance strategies (e.g. mindfulness, acceptance or willingness; for further details see 2.1.3).

Thirdly, Aldao et al. (2010) showed that different emotion regulation strategies are related differently to psychopathology. The authors found that dispositional maladaptive strategies (i.e. suppression, rumination, avoidance) were related to psychopathology, while dispositional adaptive strategies (i.e. reappraisal, acceptance and problem solving) were inversely related to psychopathology. Therefore, the efficacy of acceptance strategies might depend on the disorder under investigation. Furthermore, acceptance strategies might operate differently in healthy vs. clinical subjects and thus depending on the target group might or might not be more effective than other emotion regulation strategies.

Fourthly, results also differ depending on the comparison condition used. Acceptance strategies have been shown to be superior to comparison conditions including distraction (Gutiérrez, Luciano, Rodríguez, & Fink, 2004), suppression (Marcks & Woods, 2005) and rumination (Singer & Dobson, 2007). In contrast, other studies have found that acceptance strategies are equally effective compared to suppression (Feldner, Zvolensky, Eifert, & Spira, 2003), distraction (Huffziger & Kuehner, 2009), and reappraisal (Hofmann et al., 2009).

1.4. Current research on acceptance strategies

Further research is needed to determine whether acceptance strategies are superior only to a specific type of emotion regulation strategy. This question is partially addressed by a meta-analytic review that focused on different emotion regulation strategies (Aldao et al., 2010). The authors found that dispositional maladaptive strategies (i.e. suppression, rumination, avoidance) were related to psychopathology, while dispositional adaptive strategies (i.e. reappraisal, acceptance and problem solving) were inversely related to psychopathology. These results indicate that there is a pattern of functional and dysfunctional strategies within emotion regulation strategies, although the authors did not directly compare the individual strategies with respect to their impact on outcome measures. Thus, acceptance might be superior to maladaptive emotion regulation strategies but not to other, adaptive emotion regulation strategies.

No systematic review has integrated experimental research comparing acceptance strategies with other emotion regulation strategies.

A systematic review has the advantage of synthesizing separate, often contradictory findings. Moreover, it is necessary to combine existing experimental results, because some findings are based on very small sample sizes and thus are more prone to bias (Roche, Forsyth, & Maher, 2007). Because research to date has left unresolved whether acceptance strategies are superior to other emotion regulation strategies, the present study aims to quantitatively assess the relative effectiveness of acceptance and other emotion regulation strategies by using meta-analytic techniques. The findings will shed more light on the question of whether (and under which circumstances) acceptance strategies should be favored compared to other strategies in therapeutic contexts.

1.5. Research questions

In sum, the present review aims at answering the following questions:

1. Are acceptance strategies generally superior to other emotion regulation strategies?
2. Are acceptance strategies superior to other emotion regulation strategies with respect to specific outcome measures?
   - 2.1. If contradictory results emerge, can they be explained by different components of acceptance strategies (such as mindfulness or acceptance)?
   - 2.2. Does the relative efficacy of acceptance vs. other emotion regulation strategies depend on the sample under study, i.e. healthy vs. clinical samples?
3. Does the superiority of acceptance strategies depend on the type of emotion regulation strategy used as a comparison condition (such as suppression or distraction)?

2. Method

The present meta-analytic review was conducted according to the guidelines of the PRISMA statement (Liberati et al., 2009).

2.1. Systematic review

2.1.1. Literature search

We selected experimental studies in which various kinds of acceptance strategies were compared with other emotion regulation strategies. Electronic literature searches were performed in PsychInfo and PubMed from 1961 to mid 2010. The following combination of search words was used: (Acceptance OR Experiential Avoidance OR Defusion OR Mindfulness) AND (Suppression OR Distraction OR Reappraisal OR Control). The search was limited to keywords in title and to journal articles only. All abstracts were read by the first author and checked for eligibility. The full article was retrieved if the study fulfilled the following inclusion criteria:

- Studies published in English journals (year of publication between 1960 and 07/2010)
- Human participants
- Using an experimental or quasi-experimental design
- Comparison between acceptance strategies and other emotion regulation strategies

Single case reports, dissertations, and studies in which the implementation of the emotion regulation strategy lasted for longer than one session were excluded.

For all selected studies, the reference list was checked against the search results, and any additional studies meeting inclusion criteria were obtained. For studies with insufficient data for effect size calculations, authors were contacted and asked to provide

additional information. Outcome measures of some studies could not be combined in one concept and some authors did not respond to the request to provide data.

2.1.2. Procedure

We collected data on sample type (e.g. healthy participants, participants with depression or anxiety), number of participants, age, gender, type of comparison condition (e.g. suppression, distraction, rumination), number and type of acceptance components, emotion induction method (e.g. emotional film, carbon dioxide air, cold pressor test), all available outcome variables, publication year, study design and drop-out rates.

2.1.3. Definition of strategies

Acceptance strategies: The term 'acceptance strategy' refers to all strategies that contained at least one component of ACT (although according to ACT acceptance is a distinct component), e.g. acceptance, self as context, values, commitment, defusion, or being present. Furthermore, all strategies were included that are labeled as acceptance strategies and that derived from an emotion regulation perspective.

The ACT model describes acceptance as the willingness to take in an event or situation (Hayes, Bissett et al., 1999). Self as context refers to the encouragement to adopt "a sense of self as a locus of perspective [that] provides a transcendent, spiritual side to normal verbal humans (…) [which is accomplished by] mindfulness, exercises, metaphors, and experiential processes" (Hayes, Luoma, Bond, Masuda, & Lillis, 2006). Values should be chosen in various domains of life instead of only reacting in accordance with thoughts and feelings, which might lead to avoidance behavior. Furthermore, commitment should be established, so that the person acts according to valued life goals through skills acquisition, shaping methods and similar techniques (Hayes, 2004; Hayes, Bissett et al., 1999; Hayes et al., 2006). The process of cognitive defusion aims at altering the function of cognitive or verbal content instead of changing their form or frequency. Moreover, a goal of defusion is to reduce the believability of private experiences (Hayes et al., 2006). It is accompanied by a non judgmental way of recognizing upcoming thoughts and feelings. The goal of practice in being present is more flexible behavior and greater consistency between action and values.

Since the concept of ACT involves mindfulness (being present) and mindfulness itself is defined as an attitude of acceptance toward unpleasant perceptions and thoughts (Majumdar, Grossman, Dietz-Waschkowski, Kersig, & Walach, 2002), we also included studies that mainly focused on mindfulness strategies without explicitly mentioning ACT.

Other emotion regulation strategies: We grouped together strategies such as suppression, distraction, and reappraisal with the term 'other emotion regulation strategies'. We also included strategies that could be termed "control-based strategies"(Hayes, Bissett et al., 1999). This term refers to strategies which aim to control the form or frequency of thoughts and feelings, such as the strategies of distraction or rumination. Emotion regulation strategies such as reappraisal and distraction are typically applied in CBT. One aim of this paper is to investigate whether the relative effectiveness of acceptance strategies differs when compared to maladaptive vs. adaptive emotion regulation strategies (Aldao et al., 2010). We will examine how many studies show that acceptance strategies are more effective than each of the most frequently used emotion regulation strategies within this review (i.e. suppression, distraction, rumination, and reappraisal).

2.1.4. Determination of outcome variables

Results were aggregated according to outcome measures, because there are contradictory results regarding the efficacy of acceptance strategies relative to other emotion regulation strategies across different outcome measures (see research question number 2).

If contradictory results appeared within one outcome measure, we sought to compare other variables (e.g. induction method, type of comparison condition or sample type) that could contribute to discrepant results. First, we will describe the results of systematically reviewing the studies. Next we will describe results of the meta-analysis.

2.2. Meta-analysis

Between-group ES (Hedge's g) were generated for negative affect, pain intensity, and pain tolerance. Hedge's g is a variation of Cohen's d that corrects for biases due to small sample sizes (Hedges & Olkin, 1984). Between-group ES were calculated using the following formula: $g = [(Y_1) - M(Y_2)/s^*]1 - 3/(4df - 1)$, where $M(Y_1)$ is the post-instruction sample mean of one group and $M(Y_2)$ is the post-instruction sample mean of the other group. The pooled standard deviation s^* is computed as follows: $s^* = \sqrt{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}$ where s_1 is the post-instruction standard deviation of one group, s_2 is the post-instruction standard deviation of the other group. n_1 and n_2 are the sample sizes of each group.

In the case of two or more groups, the more adaptive and the more active[1] emotion regulation group was chosen, because we assume that acceptance is an effective strategy in general and we were thus more interested in comparing acceptance with other established strategies. This approach led to less heterogeneity, as most of the studies used either suppression or distraction.

The magnitude of Hedge's g can be interpreted according to Cohen's recommendations of small (0.2), medium (0.5) and large (0.8) effects (Cohen, 1988).

All analyses were done using the software program Comprehensive Meta-Analysis, version 2 (Borenstein, Hedges, Higgins, & Rothstein, 2005). Pre- and post-instruction means and standard deviations as well as number of participants were entered into the program for each study. The ES were calculated using a random-effects model because we expected no functional equivalence across the studies (Hedges & Vevea, 1998).

The homogeneity of effects was calculated by the Q-statistic. Significant Q-statistics indicate homogeneity of ES across studies. We also calculated I^2 to assess the amount of variance due to heterogeneity across studies.

Studies with non-significant results are less likely to be published and that fact may bias results within a meta-analysis. To address this potential bias, we computed the fail-safe N, which estimates the number of additional studies that would be required to reduce the overall ES to a non-significant level. An ES can be considered as robust if fail-safe N exceeds $5k + 10$ (Rosenthal, 1991) with k being the number of studies in the meta-analysis.

3. Results

3.1. Description of the studies

The initial search strategy identified 143 potential articles (see Fig. 1). 114 studies did not fulfill the inclusion criteria because they did not directly compare acceptance strategies with other emotion

[1] We preferred distraction over suppression or rumination, because we assumed distraction is more adaptive than the latter emotion regulation strategies. The more active group was chosen, when we had to decide between placebo or no instruction vs. positive self-verbalization.

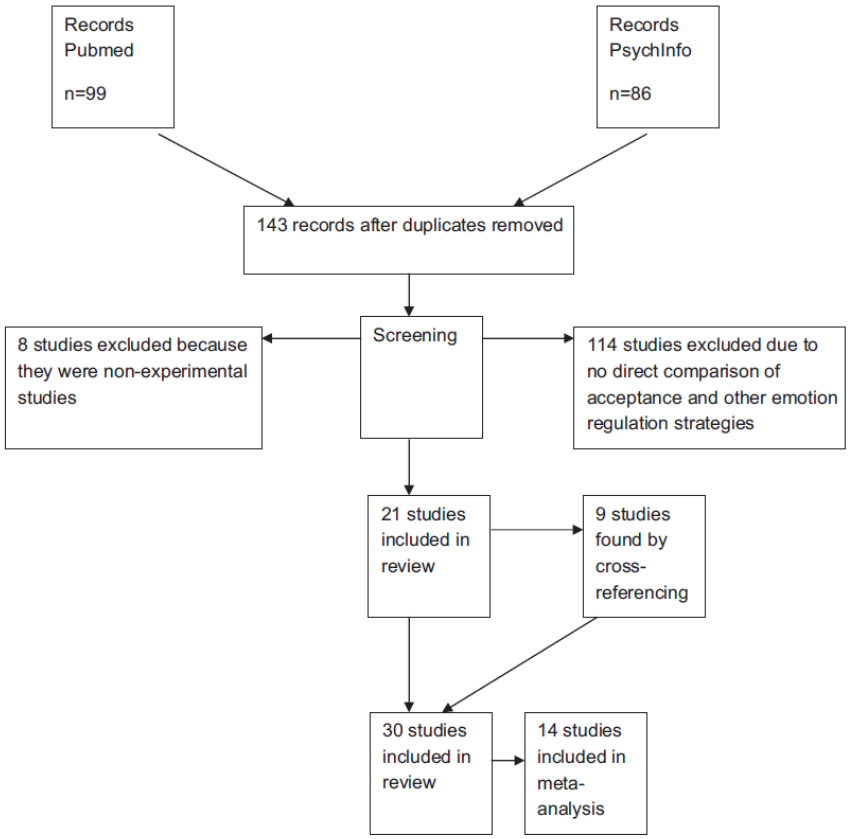

Fig. 1. Study selection process.

regulation strategies. Eight studies were excluded because they did not use experimental designs. Twenty-one studies met the inclusion criteria. An additional nine studies were found by cross-referencing, so that 30 studies were included in the systematic review. Out of the 30 studies data from 14 studies was included in the meta-analysis.

In total, 2085 participants were included in the systematic review, of which 64% were female (for a detailed description of studies see Table 1). Mean age was 25.56 years. All studies were published between 1999 and 2010. The majority of studies consisted of healthy participants ($k = 21$), three studies included an anxiety sample, three studies included depressed participants (in one study partly remitted, in one study fully remitted depressed patients), one study included obsessive-compulsive patients as well as healthy participants, one study included tinnitus patients, and one study included a low back pain sample.

Studies also differed on the number and type of emotion regulation strategies, with 19 studies employing more than one comparison condition. Comparison conditions were 'suppression' in 12 studies, 'distraction' in eleven studies, 'rumination' in four studies, and 'reappraisal' in two studies. The remaining emotion regulation groups varied in content.

Acceptance strategies varied with respect to the number and type of components and how they were applied. In 18 studies, two components of what we defined as 'acceptance strategies' could be identified, in seven reports the acceptance strategy involved only one component (e.g. willingness), and five studies had three components (e.g. values, defusion, mindfulness). 'Willingness' was included in 19 studies, 'mindfulness' in 16, 'defusion' in eleven, acceptance in six, and 'values' in six. Fifteen studies used examples, metaphors, or exercises to clarify the instructions (seven studies used one of these features, six studies used two, and two studies used three). Studies that did not use metaphors, examples or exercises presented the acceptance instructions via headphones or participants simply read the instructions.

The most frequently used outcome variables can be grouped together under the term 'negative affect', including distress, discomfort, or negative mood (19 studies). The manipulation of aversive states (such as negative affect, intrusive thoughts, cravings, anxiety and pain) was conducted differently across studies. Four studies induced negative affect via an emotional film and in three studies participants were exposed to carbon dioxide-enriched air. Four studies used emotional music and in one study, participants had to write about a stressful event. In two studies participants were exposed to loud noise. Four studies used self-statements to induce intrusive thoughts. The second most frequently used outcome variables were pain intensity and pain tolerance (ten studies used pain intensity as an outcome, and nine used pain tolerance). Five studies used the cold pressor test to induce pain, four studies applied electric stimulation and one study conducted the physical impairment test to assess physical functioning. In one study participants were given chocolate to induce craving and in another one, subjects had to deliver an impromptu speech to induce anxiety.

One study used a within-subject design, three studies had a mixed-between-within design, and the others used a between-subject design. In all studies participants were randomly assigned to the conditions.

Table 1
Characteristics of included studies.

Author (year)	Sample	Manipulation	Type of strategy/independent variable (features with which acceptance strategy is explained)	Outcome measure/ dependent variable (measurement)	Results	Data for effect size calculation
Pain						
Branstetter-Rost et al. (2009)	95 students 61% female	Cold pressor test	- Acceptance (exercise, metaphor): defusion, willingness (+values: life goal) - Control: reading about state constitution	Tolerance (time length under water) Pain intensity (VAS[a])	↑[b] ↓[c]	No
Páez-Blarrina, Luciano, Gutiérrez-Martínez, Valdivia, Ortega et al., 2008;	30 students 70% female	Electric shocks	- Acceptance (personal example): values, willingness - Control: pain as barrier for action Coping: - Acceptance (metaphor, example): defusion, mindfulness - Control: suppression	Tolerance (number of shocks); believability (relation pain and tolerance) Pain intensity (VAS)	↑ ↓	No
McMullen et al. (2008)	80 students 58% female	Electric shocks	Full version - Acceptance (metaphor, exercise): defusion, mindfulness, values - Control: distraction Short version - Acceptance (without metaphor, exercise): acceptance, willingness, mindfulness - Control: distraction	Full version Tolerance (number of shocks) Pain intensity (VAS) Short version Tolerance (number of shocks); believability (relation between pain and tolerance, no test of significance) Pain intensity (VAS)	 ↑ ◆[d] ↑ ◆	Yes
Páez-Blarrina, Luciano, Gutiérrez-Martínez, Valdivia, Rodríguez-Valverde et al., 2008	20 students 80% female	Electric shocks	- Acceptance (metaphor, exercise): defusion, mindfulness - Control: suppression	Tolerance (number of shocks); pain intensity (VAS) Believability (relation between tolerance and pain)	◆ ↑	Yes
Roche et al. (2007)	20 students 70% female	Cold pressor test	- Acceptance (physical metaphor, examples, metaphors): willingness, mindfulness (+high demand: i.e. eye contact, experimenter sitting close to subject) - Control: never giving up, mental strategies (+high demand: see above)	Tolerance (length of time under water); pain intensity (NRS[e]); unpleasantness (NRS)	↑	Yes
Vowles et al. (2007)	74 low back pain patients 30% female	Physical impairment index	- Acceptance (metaphor): willingness, acceptance - Control 1: control pain - Control 2: Continued practice	Pain intensity (NRS) Overall functioning (PII[f])	◆ ↑	No
Masedo and Rosa Esteve (2007)	55 students 52% female	Cold pressor test	- Acceptance (example, exercise): willingness, defusion - Control 1: suppression of thoughts, perceptions - Control 2: spontaneous coping	Tolerance (length of time under water); pain recovery (2 ratings after hand removed); distress recovery (2 ratings after hand removed); distress (NRS); pain intensity (NRS)	↑	No
Keogh et al. (2005)	62 students 50% female	Cold pressor test	Within design - Acceptance: defusion, willingness - Control: distraction, ignore perceptions	Tolerance (length of time under water); pain threshold (length of time until painful) Sensory pain (SF-MPQ[g])	◆ ↑	No

Gutiérrez et al. (2004)	40 students 75% female	Electric shocks	- Acceptance (example, metaphor, exercise): defusion, willingness, values - Control: control pain, positive thoughts/ emotions, distraction	Tolerance (Number of shocks); believability (relationship between pain and tolerance) Pain intensity (VAS)	↑ ↓	Yes
Hayes et al. (1999)	32 students	Cold pressor test	- Acceptance (example, exercise): mindfulness, defusion - Control 1: positive self-verbalization, controlled breathing, positive images - Control 2: placebo, education about pain	Tolerance (length of time under water) Pain (NRS)	↑ ◆	Yes
Negative affect						
Najmi et al. (2009)	20 obsessive-compulsive disorder (OCD) patients 55% female 20 healthy participants 65% female	Unwanted intrusive thoughts	- Acceptance (metaphor): mindfulness, willingness - Control 1: focused distraction on weekend description - Control 2: suppression	OCD patients Distress (Thought form[h]) Frequency of unwanted thoughts (clicker): Healthy participants Distress (Thought form) Frequency of unwanted thoughts (clicker)	 Acceptance [vs. Control 2] ↑ Acceptance [vs. Control 2] ↑ Acceptance [vs. Control 1] ◆ ◆ ◆	No
Campbell-Sills et al. (2006)	60 participants with anxiety or mood disorder 50% female	Emotional film	- Acceptance: willingness - Control: suppression of emotional reactions	Negative affect (PANAS[i]): Heart rate Respiratory sinus arrhythmia; skin conductance level	↑ ?[i] ◆	Yes
Eifert and Heffner (2003)	60 high anxiety sensitive females	CO_2	- Acceptance (physical metaphor): willingness - Control 1: diaphragmatic breathing - Control 2: no instruction	Distress (SUDS[k]); heart rate; skin conductance level Latency to begin next trial; cognitive symptoms (DSQ[l]); fear (DSQ) Drop-out; willingness to return; catastrophic thoughts (DSQ)	◆ Acceptance [vs. Control 1] ↑ ↑	Yes
Healy et al. (2008)	60 students 52% female	Negative and positive self-statements	Presentation format - Acceptance: statement with prefix - Control 1: statement without prefix - Control 2: statement with no related prefix Coping strategy - Acceptance: prefix decreases meaning - Control 1: prefix increases meaning - Control 3: prefix neutral impact on meaning	Presentation format/negative statements Discomfort (NRS); willingness (NRS); believability (NRS) Presentation format/positive statements Discomfort (NRS); believability (NRS) Willingness (NRS)	 ↑ ◆ ↑	No
Erisman and Roemer (2010)	30 healthy participants 50%female	Emotional film: distressing vs. positive vs. affectively mixed film clips	- Acceptance (exercise): mindfulness - Control: excerpts from public radio station, word search puzzle	Negative affect (PANAS) Heart rate; skin conductance level	Acceptance [for affectively mixed film clips] ↑ ◆	Yes
Marcks and Woods (2005)	103 students 69% female	Personally relevant intrusive thoughts	- Acceptance (metaphor): mindfulness, willingness - Control 1: suppression - Control 2: monitor only	Discomfort (NRS) Frequency of intrusive thoughts	Acceptance [vs. Control 1] ↑ ◆	Yes
Liverant et al. (2008)	60 depressive participants 67% female	Emotional film	- Acceptance: willingness - Control: suppression of emotional reactions	Negative affect (PANAS) Sadness (ERM[m])	◆ ↑	No
Low et al. (2008)	81 students 58% female	Writing about stressful situation	- Acceptance: mindfulness, willingness - Control 1: judgment of emotional response - Control 2: focusing on objective facts	Negative affect (PANAS2[n]) Heart rate	◆ ?	Yes

(*continued on next page*)

Table 1 (*continued*)

Author (year)	Sample	Manipulation	Type of strategy/independent variable (features with which acceptance strategy is explained)	Outcome measure/ dependent variable (measurement)	Results	Data for effect size calculation
Masuda et al. (2010)	132 students 77% female	Negative self-referential thoughts	- Acceptance (example): defusion - Control 1: thought distraction - Control 2: article about Japan	Discomfort (VAS) Believability (VAS)	↑ ↑	Yes
Singer and Dobson (2007)	80 remitted depressed participants 76% female	Mood-suggestive music combined with recall of negative mood-evoking events	- Acceptance: mindfulness, acceptance - Control 1: distraction with mental images - Control 2: rumination about symptoms, emotions and self - Control 3: no training	Negative mood (VAS) Attitudes toward neg. experiences (ATNES[o])	Acceptance [vs. Control 2, 3] ↑ Acceptance [vs. Control 1] ◆ ↑	Yes
Huffziger and Kuehner (2009)	76 partly remitted depressed 50% female	Mood-suggestive music combined with recall of negative mood-evoking events	- Acceptance: mindfulness, acceptance - Control 1: distraction to other thoughts - Control 2: rumination about self-focused thoughts	Negative affect (PANAS)	Acceptance [vs. Control 2] ↑ Acceptance [vs. Control 1] ◆	Yes
Kuehner et al. (2009)	60 students 50% female	Mood-suggestive music combined with recall of negative mood-evoking events	- Acceptance: mindfulness, acceptance - Control 1: distraction to other thoughts - Control 2: rumination of self-focused thoughts	Negative affect (PANAS); Cortisol Dysfunctional attitudes (DAS[p])	◆ Acceptance [vs. Control 2] ↑ Acceptance [vs. Control 1] ◆	Yes
Westin et al. (2008)	47 tinnitus patients 51% female	White noise	- Acceptance: willingness, mindfulness - Control 1: suppression, distraction - Control 2: reminder of general instruction	Loudness; annoyance (Likert scale 1–10) Focusing on inner image (time length)	◆ Acceptance [vs. Control 2] ↑ Acceptance [vs. Control 1] ◆	Yes
Broderick (2005)	177 students 78% female	Mood-suggestive music and statements with depressive content	- Acceptance: mindfulness, self acceptance - Control 1: rumination (self-focused statements) - Control 2: distraction (think about other things than self)	Negative affect (PANAS) Frequency of neutral thoughts (Thought listing[q])	↑ Acceptance [vs. Control 1] ↑ Acceptance [vs. Control 2] ◆	Yes
Dunn et al. (2009)	89 healthy participants 55% female	Distressing film; affective picture task	- Acceptance: willingness, mindfulness - Control 1: suppression of internal and external emotional response - Control 2: no strategy	Distressing film Heart rate; mood recovery (VAS); emotion rating (VAS) Skin conductance level Affective picture task Distress (VAS) Skin conductance level; heart rate Negative affect (PANAS)	◆ ? Acceptance [vs. Control 1] ↑ ? Acceptance [vs. Control 2 one week later] ↓	Yes
Feldner et al. (2003)	48 healthy participants 56% female	CO_2	- Acceptance: mindfulness, willingness - Control: suppression of internal and external expressed emotions	Affective distress (SUDS, SAM[r]) Heart rate	◆ ?	No
Luciano et al. (2010)	35 students 87% female	Loud noise	- Acceptance (example, exercise): values, defusion, mindfulness - Control: private experiences as barriers to action (+reversed order)	Discomfort (VAS)	↑	No
Other outcome measures						
Forman et al. (2007)	98 students 48% female	Keeping chocolate candies without eating them	- Acceptance: defusion, willingness, acceptance - Control 1: no intervention - Control 2: distraction, positive imagery, restructuring	Chocolate consumption Craving (FCQ-S[s])	◆ Acceptance [under high susceptibility of food] ↑	No

Levitt et al. (2004)	60 panic disorder patients 63% female	CO_2	- Acceptance: willingness, values - Control 1: suppression - Control 2: article (national geographic)	Anxiety (NRS); avoidance (NRS) Panic symptoms (MASQ-AA[t]); heart rate; skin conductance level	↑ ◆	No
Hofmann et al. (2009)	201 students 59% female	Impromptu speech	- Acceptance: willingness - Control 1: Reappraisal, i.e. taking a realistic perspective - Control 2: external suppression of emotions	Anxiety (STAI[u]); heart rate [Acceptance vs. Control 1]; length of speech Heart rate	◆ Acceptance [vs. Control 2] ?	No

[a] VAS: Visual analog scale.
[b] ↑ favoring acceptance strategy.
[c] ↓ favoring symptom control strategy.
[d] ◆ no differences between acceptance and symptom control strategy.
[e] NRS: Numerous rating scales.
[f] PII: Physical Impairment Index (Waddell, Somerville, Henderson, & Newton, 1992).
[g] SF-MPQ: Short Form McGill Pain Questionnaire (Melzack, 1987).
[h] Thought form Najmi et al. (2009).
[i] ?: complex pattern, where acceptance and control strategies cannot be compared directly.
[j] PANAS: Positive and Negative Affect Scale (Watson, Clark, & Tellegen, 1988).
[k] SUDS: Subjective Units of Distress (Wolpe, 1982).
[l] DSQ: Diagnostic Symptom Questionnaire (Rapee, Brown, Antony, & Barlow, 1992).
[m] ERM: Emotion Rating Measure (Liverant et al., 2008).
[n] PANAS 2: Positive and Negative Affect Schedule (Watson & Clark, 1994).
[o] ATNES: Attitude Towards Negative Experiences Scale (Singer & Dobson, 2007).
[p] DAS: Dysfunctional Attitude Scale (German version: Hautzinger et al., 2005).
[q] Thought Listing (Cacioppo & Petty, 1981).
[r] SAM: Self-assessment manikin (Bradley & Lang, 1994).
[s] FCQ-S: Food Craving Questionnaire – State Version (Cepeda-Benito, Gleaves, Williams, & Erath, 2000).
[t] MASQ-AA: Mood and Anxiety Symptom Questionnaire- Anxious Arousal (Watson & Clark, 1991).
[u] STAI: State Trait Anxiety Inventory (Spielberger, Gorsuch, & Lushene, 1970).

Thirteen studies reported drop-outs (defined as discontinuation when participants were originally included in the study). In three studies that used a pain induction procedure via cold pressor test, on average 53% of participants were excluded due to ceiling effects at baseline. The remaining ten studies with reported discontinuation had an average drop-out rate of 9%.

3.2. General superiority of acceptance strategies to other emotion regulation strategies

Due to the results of the considered studies, we failed to prove a general superiority of acceptance strategies to other emotion regulation strategies.

3.3. Relative efficacy of acceptance strategies for specific outcome measures

The second research question was whether acceptance strategies are superior to other emotion regulation strategies with respect to specific outcome measures. Because one third of the included reports dealt with pain induction scenarios, results are separated into two main sections: 'Pain' and 'Other outcome variables'.

Under these headings, results are aggregated according to the most widely used outcome measures across the studies (i.e. pain tolerance, pain intensity, overall functioning, negative affect, psychophysiological variables, believability of private experiences). For each outcome category, we describe results of the systematic review followed by the results of the meta-analysis. Results that did not fit into one of the above categories are listed under the heading 'other findings'. Because different methods were used to induce negative affect, we report these results in sections according to the type of induction (e.g. negative mood, intrusive thoughts).

3.3.1. Pain

Nine studies that used pain induction procedures in healthy participants fit the criteria for the present review. Five of these studies induced pain with the cold pressor test and four studies induced pain by electric shocks. One additional study investigated the impact of an acceptance instruction (and a continued practice group) in a clinical sample of patients with chronic low back pain (Vowles et al., 2007).

3.3.1.1. Pain tolerance. Six studies found that an acceptance strategy prolonged the exposure to painful stimuli more than another emotion regulation strategy (Branstetter-Rost, Cushing, & Douleh, 2009; Gutiérrez et al., 2004; Hayes, Bissett et al., 1999; Masedo & Rosa Esteve, 2007; McMullen et al., 2008; Páez-Blarrina, Luciano, Gutiérrez-Martínez, Valdivia, Ortega et al., 2008). Three studies did not find that acceptance strategies increased pain tolerance relative to other emotion regulation strategies (Keogh, Bond, Hanmer, & Tilston, 2005; Páez-Blarrina, Luciano, Gutiérrez-Martínez, Valdivia, Rodríguez-Valverde et al., 2008; Roche et al., 2007).

In sum, the majority of studies showed that acceptance strategies are superior to other emotion regulation strategies in increasing pain tolerance.

We calculated the random effect model of the between-group ES and showed a significant mean ES of $g = 0.43$ for pain tolerance ($Z = 2.75$, $p < 0.01$; $k = 7$; 95% CI[0.12, 0.73] see Table 2). The test of heterogeneity yielded a non-significant Q-value (6.09). ES was in a small to medium range. The fail-safe N was four and did not exceed $5k + 10$ and the effect sizes therefore cannot be regarded as robust.

To summarize, ES calculation indicate a superiority of acceptance strategies compared to other emotion regulation strategies.

Table 2
Average between-group effect sizes for the outcome measures pain tolerance, pain intensity and negative affect.

	g[a]	Q[b]	I^2[c]	Fail-safe N[d]
Pain tolerance	0.43	6.09	1.46	7
Pain intensity	−0.08	6.38	6	0
Negative affect	0.01	25.96	53.77	0

[a] g = Hedge's g between-group effect sizes.
[b] Q = Indicator of heterogeneity.
[c] I^2 = amount of variance due to heterogeneity within studies.
[d] Fail-safe N = number of unpublished and non-significant studies that would reduce effect size to a non-significant level.

A further research question was whether contradictory results on the relative efficacy of acceptance strategies can be explained by differing components of acceptance strategies.

Two studies showed a beneficial effect of acceptance strategies on pain tolerance, particularly when acceptance was embedded in a values-based context (Branstetter-Rost et al., 2009; Páez-Blarrina, Luciano, Gutiérrez-Martínez, Valdivia, Rodríguez-Valverde et al., 2008). McMullen et al. (2008) also found that the acceptance strategy was only superior to another emotion regulation strategy when the acceptance instruction included a metaphor and an exercise.

An additional question was whether differences between strategies emerge only in healthy or only in clinical participants. This cannot be answered for the outcome measure of pain tolerance, because all studies included only healthy participants.

The following differences were detected between studies that found acceptance strategies to be superior and studies that did not: The study by Keogh, Bond, Hammer, and Tilston (2005) was the only one that used a within-subject design, and this study did not obtain any differences between acceptance and other emotion regulation instructions. Two of the studies that did not find acceptance to be superior should be interpreted with caution due to small sample sizes of 20 participants (Páez-Blarrina, Luciano, Gutiérrez-Martínez, Valdivia, Rodríguez-Valverde et al., 2008; Roche et al., 2007). No systematic differences on pain induction method were identified between studies finding acceptance strategies vs. other emotion regulation strategies to be superior.

3.3.1.2. Pain intensity. The results of two studies indicated that an acceptance strategy was more effective at reducing pain intensity compared to another emotion regulation strategy[2] (Keogh et al., 2005; Masedo & Rosa Esteve, 2007). Three studies found reduced pain intensity ratings for other emotion regulation strategies but not for acceptance strategies (Branstetter-Rost et al., 2009; Gutiérrez et al., 2004; Páez-Blarrina, Luciano, Gutiérrez-Martínez, Valdivia, Ortega et al., 2008). The remaining studies did not find any differences between acceptance and other emotion regulation instructions with respect to pain intensity (Hayes, Bissett et al., 1999; McMullen et al., 2008; Páez-Blarrina, Luciano, Gutiérrez-Martínez, Valdivia, Ortega et al., 2008; Roche et al., 2007; Vowles et al., 2007).

Thus, results of the systematic qualitative review are inconclusive with respect to pain intensity, with a slight majority of studies finding that acceptance was inferior to other emotion regulation strategies in reducing the intensity of pain.

The result of the meta-analysis using a random effect model showed an insignificant mean between-group ES of $g = -0.08$

[2] Keogh et al. (2005) showed that the acceptance group had lower sensory pain ratings than the group and that the acceptance strategy decreased affective pain ratings, but this was only found among women.

($Z = -0.51$, $p = 0.61$; $k = 7$; 95% CI[−0.39, 0.23] see Table 2). The Q-value (6.38) was not significant. The fail-safe *N* was zero. Thus, the existing results should be considered preliminary.

Because results did not show a difference between acceptance strategies and other emotion regulation strategies for reducing pain intensity, potential explanations for differential efficacy (e.g. components of acceptance strategies, sample type) are not reviewed.

3.3.1.3. Overall functioning. The question of whether acceptance strategies show advantages over other emotion regulation strategies with respect to overall functioning within pain management was only addressed by one study: Vowles et al. (2007) found that the acceptance group showed greater overall functioning on a set of seven standardized physical tasks in comparison to the other two instruction sets, which led to an increased impairment.

3.3.2. Other outcome variables

3.3.2.1. Negative affect. Sixteen studies compared the effect of acceptance strategies with that of other emotion regulation strategies on one of the variables 'discomfort', 'distress' and 'negative affect', which we grouped together under the term 'negative affect'. As mentioned above, we segregated the results according to the type of induction (e.g. negative mood induction, intrusive thought induction, etc.), because the efficacy of different coping strategies may depend on the particular nature of the negative affective state.

3.3.2.1.1. Negative mood induction. Five studies, which used different procedures to induce negative mood (e.g. mood-suggestive music or an emotional film, for more details see Table 1), found that acceptance strategies were more effective than were other emotion regulation strategies at decreasing negative affect[3] (Broderick, 2005; Campbell-Sills, Barlow, Brown, & Hofmann, 2006; Erisman & Roemer, 2010; Huffziger & Kuehner, 2009; Kuehner, Huffziger, & Liebsch, 2009; Singer & Dobson, 2007). Five studies did not find that acceptance strategies were more effective than either a suppression or a non-specific group (Dunn et al., 2009; Erisman & Roemer, 2010; Liverant et al., 2008) or a distraction group (Kuehner et al., 2009; Low, Stanton, & Bower, 2008).

One study found an adverse effect of acceptance: participants reported increased negative affect one week after the experiment (Dunn et al., 2009).

Thus, findings were mixed with respect to relative efficacy of acceptance vs. other emotion regulation strategies after negative mood induction.

Discrepant results on the relative efficacy of acceptance strategies did not appear to be attributable to use of different components of acceptance strategies.

Three of the studies that found acceptance strategies to be superior used clinical samples (Campbell-Sills et al., 2006; Huffziger & Kuehner, 2009; Singer & Dobson, 2007), while the remaining two used healthy participants (Broderick, 2005; Erisman & Roemer, 2010). The majority of studies that did not find acceptance strategies to be more effective than other emotion regulation strategies included only healthy participants. It is possible that acceptance strategies are particularly beneficial among clinical populations, although additional research is needed.

3.3.2.1.2. Induction of intrusive thoughts. Three studies found that acceptance was more effective than suppression (Marcks & Woods, 2005; Najmi, Riemann, & Wegner, 2009) or distraction (Masuda et al., 2010) at reducing negative affect due to induction of intrusive thoughts. In addition, Healy et al. (2008) found that discomfort decreased when a negative statement was presented in a defused format ("I am having the thought"). When the statement was presented without a prefix or with an irrelevant one, no impact on the discomfort rating emerged.

3.3.2.1.3. Carbon dioxide air. Following inhalation of carbon dioxide-enriched air, acceptance strategies showed no advantage over inhibition of emotions (Feldner et al., 2003) or control-based strategies (Eifert & Heffner, 2003) with respect to reducing negative affect.

3.3.2.1.4. Other aversive stimulation. Luciano et al. (2010) found that acceptance strategies, in comparison with experiential avoidance strategies, led to reduced discomfort at loud noises during a computer task.

Westin et al. (2008) found no differences between groups of tinnitus patients receiving acceptance vs. suppression instructions on self-reported annoyance due to white noise during a mental imagery task.

We conducted a meta-analysis for all studies in which negative affect, distress, discomfort, or annoyance (regardless of induction method) served as an outcome measure and from which pre- and post-induction data were available. The meta-analysis using a random effect model revealed a non-significant mean ES of $g = 0.01$ ($Z = 0.09$, $p = 0.93$; $k = 13$; 95% CI[−0.21, 0.23]; see Table 2). The Q-value (25.96) showed a significant result ($p < 0.05$). The fail-safe *N* was zero, indicating that publication bias is likely to account for the results.

In sum, while the systematic qualitative review suggested a possible advantage of acceptance strategies for reducing experimentally-induced negative affect, particularly among clinical participants, the meta-analysis found no differences between groups. Contradictory results between studies were not explained by use of different components of acceptance strategies across studies.

3.3.2.2. Psychophysiology

3.3.2.2.1. Heart rate. The first question was whether acceptance strategies lead to a more adaptive response in heart rate relative to other emotion regulation strategies. Several studies found differences between acceptance and other emotion regulation strategies with respect to heart rate variability (Campbell-Sills et al., 2006; Dunn et al., 2009; Feldner et al., 2003; Hofmann et al., 2009; Low et al., 2008). However, as results showed different patterns, it is not possible to draw conclusions regarding relative efficacy. Hofmann et al. (2009), for example, showed an increase from baseline to exposure and a decrease from exposure to recovery for the acceptance group, whereas Campbell-Sills et al. (2006) found a decrease from baseline to exposure and an increase from exposure to recovery for the acceptance group.

Four studies failed to detect any group differences in heart rate (Dunn et al., 2009; Eifert & Heffner, 2003; Erisman & Roemer, 2010; Levitt et al., 2004).

3.3.2.2.2. Electrodermal activity (EDA). Dunn et al. (2009) found a smaller increase in EDA response from exposure to recovery period in the acceptance group compared to the suppression and the other group. Furthermore, participants who received the acceptance instruction showed a greater EDA response than the other two groups during the affective picture task.

In contrast, three studies did not find any group differences in skin conductance level (Campbell-Sills et al., 2006; Eifert & Heffner, 2003; Erisman & Roemer, 2010).

To summarize, we failed to detect an advantage of acceptance strategies over other emotion regulation strategies for psychophysiological outcome variables.

[3] Erisman and Roemer (2010) found acceptance to be superior only when negative mood was induced through an affectively mixed film clip (not when using distressing film clips).

3.3.2.3. Believability of private experiences. Low levels of believability indicate that participants are not convinced of the necessity to act upon all inner experiences (such as thoughts and perceptions). A number of studies found that acceptance strategies were more helpful in reducing the believability of private experiences than were other emotion regulation strategies (Gutiérrez et al., 2004; Hayes, Bissett et al., 1999; Healy et al., 2008; Masuda et al., 2010; McMullen et al., 2008; Páez-Blarrina, Luciano, Gutiérrez-Martínez, Valdivia, Ortega et al., 2008; Páez-Blarrina, Luciano, Gutiérrez-Martínez, Valdivia, Rodríguez-Valverde et al., 2008).

3.3.2.4. Other findings. Two studies found a positive effect of acceptance strategies for the emergence of neutral thoughts (Broderick, 2005) and for a lesser extent of unwanted thoughts (Najmi et al., 2009) compared to other emotion regulation strategies. Contrary to this, Marks and Woods (2005) did not find evidence for acceptance strategies reducing the frequency of thoughts.

Additional studies found that acceptance strategies, compared to other emotion regulation strategies, had a greater influence on avoidance behavior (Eifert & Heffner, 2003; Healy et al., 2008; Levitt et al., 2004), the amount of fear (Eifert & Heffner, 2003; Levitt et al., 2004), cognitive symptoms, and catastrophic thoughts (Eifert & Heffner, 2003) within a carbon dioxide challenge.

Erisman and Roemer (2010) found that participants in the mindfulness condition reported greater positive affect in response to positive film clips than did participants in the other emotion regulation group. In contrast, Liverant et al. (2008) found that participants in the acceptance group showed a greater increase in sadness from anticipation to exposure than did the suppression group (although the acceptance group decreased more steeply from exposure to recovery, as mentioned above).

Singer and Dobson (2007) showed that the acceptance group had a significantly greater reduction in negative attitudes toward negative experiences compared to the rumination and the distraction group.

Westin (2008) found that acceptance strategies were more beneficial in increasing ability to focus on tasks without interruption than when participants received no specific strategy.

Forman et al. (2007) found that an acceptance strategy was more helpful in coping with food cravings compared to distraction and restructuring strategies, especially for participants who were highly susceptible to the presence of food.

3.4. Superiority of acceptance strategies to suppression, distraction, rumination and reappraisal

Our next research question was whether the relative efficacy of acceptance strategies depends on the nature of the comparison of emotion regulation strategy. Studies are reviewed across the most frequently used outcome measures within this meta-analytic review (negative affect, pain intensity and pain tolerance).

In seven studies, acceptance strategies were superior to suppression strategies (Campbell-Sills et al., 2006; Dunn et al., 2009; Liverant et al., 2008; Marcks & Woods, 2005; Masedo & Rosa Esteve, 2007; Najmi et al., 2009; Páez-Blarrina, Luciano, Gutiérrez-Martínez, Valdivia, Ortega et al., 2008). Five studies found no significant difference between acceptance and suppression strategies (Dunn et al., 2009; Feldner et al., 2003; Najmi et al., 2009; Páez-Blarrina, Luciano, Gutiérrez-Martínez, Valdivia, Rodríguez-Valverde et al., 2008; Westin et al., 2008). (Note: Dunn et al. (2009) and Najmi et al. (2009) were mentioned twice, as the first group found differences for an affective picture task but not for a distressing film, and the latter group found differences for the clinical sample but not for healthy participants).

Three studies found that acceptance strategies were more effective than distraction strategies (Broderick, 2005; Gutiérrez et al., 2004; Masuda et al., 2010). Seven studies did not find any significant differences between acceptance and distraction strategies (Huffziger & Kuehner, 2009; Keogh et al., 2005; Kuehner et al., 2009; McMullen et al., 2008; Najmi et al., 2009; Singer & Dobson, 2007; Westin et al., 2008).

Three studies found that acceptance strategies were more effective than rumination (Broderick, 2005; Huffziger & Kuehner, 2009; Singer & Dobson, 2007), while one did not find significant differences between acceptance and rumination (Kuehner et al., 2009).

Hofmann et al. (2009) and Forman et al. (2007) were the only studies to compare acceptance and reappraisal. Results indicated no significant differences between acceptance and reappraisal with respect to the outcomes of anxiety and craving. However, because these studies focused on outcome variables other than negative affect, pain tolerance, or pain intensity, results could not be included in the meta-analysis.

4. Discussion

4.1. Summary of results

This is the first systematic review to investigate the efficacy of acceptance strategies relative to various other emotion regulation strategies in experimental designs. We found that acceptance strategies were not generally superior to other emotion regulation strategies. The qualitative review and meta-analysis yielded contradictory results regarding whether relative efficacy of acceptance strategies depended on the outcome measure. For some outcome measures, differences emerged between acceptance and other emotion regulation strategies for different sample types. Acceptance strategies were especially superior to so-called maladaptive emotion regulation strategies (such as rumination and suppression).

4.2. General superiority

The first question of this review was whether acceptance strategies are generally superior to other emotion regulation strategies. Overall, acceptance strategies do not appear to be more effective than other emotion regulation strategies when the goal is reduction of feelings of pain or negative affect. They do appear superior when the goal is performance based, as in pain tolerance. Our results are also consistent with those of Powers et al. (2009), who found advantages of ACT compared to psychological placebos, but not compared to established treatments such as CBT.

4.3. Acceptance vs. other emotion regulation strategies according to outcome measures

The question of whether acceptance strategies are superior to other emotion regulation strategies with respect to specific outcome measures was not clearly answered.

4.3.1. Pain tolerance

The qualitative review suggests that acceptance strategies are more useful in increasing pain tolerance than other emotion regulation strategies. Our meta-analytic findings also showed significant differences between acceptance and other emotion regulation strategies on pain tolerance. This is in line with assumptions made by ACT: Acceptance aims to disconnect the link between thoughts and behaviors so that patients are willing to tolerate pain longer despite of their opponent thoughts and feelings (McCracken, Vowles, & Eccleston, 2004). There is evidence that

more detailed explanations of the content of acceptance strategies to participants are associated with a greater advantage of acceptance strategies over other emotion regulation strategies with respect to increasing tolerance for painful stimulation (Branstetter-Rost et al., 2009; McMullen et al., 2008; Páez-Blarrina, Luciano, Gutiérrez-Martínez, Valdivia, Ortega et al., 2008).

4.3.2. Pain intensity

There is little support for the superiority of acceptance strategies relative to other emotion regulation strategies at reducing perceived pain intensity. This result is in line with assumptions made by ACT, because reducing pain itself is not the aim of ACT. Rather, ACT aims at altering the function instead of altering the form or frequency of private events (Branstetter-Rost et al., 2009; Gutiérrez et al., 2004).

4.3.3. Negative affect

Results are heterogeneous among studies in which acceptance strategies were applied to reduce negative affect resulting from negative mood induction. According to the ACT model, acceptance does not target on reducing emotional distress, but results show that acceptance decreases negative affect under certain conditions. On the one hand, it seems as if superiority of acceptance over other emotion regulation strategies emerged more easily in clinical samples than in samples with healthy participants. It is possible that clinical participants are more experienced in dealing with symptoms in an accepting manner, although they may have been unsuccessful in doing so thus far. However, when given an adequate acceptance strategy, they may be able to handle it. Regarding the decrease of negative affect due to the induction of intrusions, acceptance seems to be a more efficient strategy relative to other emotion regulation strategies. However, no advantage of acceptance strategies emerged over other emotion regulation strategies following a carbon dioxide challenge. Meta-analytic results did not show any differences in ES between acceptance and other emotion regulation strategies for negative affect. Thus, no final conclusion can be drawn.

4.3.4. Psychophysiology

Our analyses did not identify a specific psychophysiological pattern in heart rate reactivity or electrodermal activity for either acceptance strategies or for other emotion regulation strategies. Presumably, psychophysiological reactions were more associated with other variables such as the type of induction (carbon dioxide vs. emotional film) than with a specific strategy.

4.3.5. Believability of private experiences

As expected, results on believability were homogeneous in showing a clear advantage of acceptance strategies. The concept of believability is related to cognitive defusion and is not a target outcome of other emotion regulation strategies.

4.3.6. Other findings

Regarding other outcome variables (grouped together under the heading "other findings"), few studies have investigated each outcome variable such that it is impossible to generalize those results. Some studies suggest that acceptance strategies produce good outcomes with respect to avoidance tendencies, in line with the focus in ACT on increasing the willingness to approach discomforting private events (Hayes, Bissett et al., 1999).

4.4. Differences of components of acceptance strategies

Another question was whether contradictory results concerning the relative efficacy of acceptance strategies can be explained by use of different components of acceptance strategies. As results from pain experiments indicate, the way in which strategies are explained and applied may be more important than differences in the components of acceptance strategies. For other outcome measures, contradictory results could not be explained by different components of acceptance strategies.

4.5. Differences in sample type

In cases in which contradictory results emerged regarding relative efficacy of acceptance strategies and other emotion regulation strategies, we investigated influences of sample type. Although in many studies the benefit of strategies such as suppression or distraction was questionable, it is possible that healthy participants are able to use so-called 'maladaptive' emotion regulation strategies without adverse effects (Aldao et al., 2010). With respect to other outcome measures, the systematical review did not indicate differences between acceptance and other strategies based on sample type (with one exception for negative mood induction, where acceptance strategies were more effective in clinical participants than in healthy samples).

4.6. Differences in the type of emotion regulation strategy

In line with the results of Aldao et al. (2010), it seems that acceptance is consistently superior to maladaptive strategies like suppression or rumination. When acceptance strategies were compared with distraction, the majority of studies indicated no differences between strategies. The comparison between acceptance and reappraisal points in the same direction, although we only included two studies that addressed this question.

4.7. Limitations of the current study

Relatively few experimental studies comparing acceptance and other emotion regulation strategies were identified; therefore the results of this review are based on a small sample of studies. Differences in results between the systematic review and the meta-analysis are not surprising, because the systematic review does not correct for random results resulting from small samples. As a meta-analysis takes the sample size and the magnitude of effects into account, meta-analytic results do not show small differences anymore. Moreover, not all studies included in the systematic review could be included in the meta-analysis. Pooling together various studies to investigate effects of the two strategy types on negative affect led to high heterogeneity within results. There are several possible explanations for this heterogeneity. First of all, we defined the concept of acceptance strategies very broad, i.e. it seems to be impossible to draw a clear line between mindfulness and acceptance, and acceptance can entail diverse strategies. It might be that possible differences in processes and effects of various strategies combined in the analysis were not investigated. Second, the method of inducing emotions or pain differed across the studies. Third, studies used diverse outcome measures, which can lead to validity problems because it is unclear whether the diverse operationalizations measure the same construct. Fourth, the type of emotion regulation strategy differed across the studies. Because of small cell sizes necessary moderator analyses could not be performed. Another problem of our methodology is the combination of different types of comparison conditions within meta-analysis, which does not allow conclusions to which kind of emotion regulation strategy, acceptance would be superior. Moreover, it is difficult to generalize results to clinical participants, because very few studies included a clinical sample. It should also be noted that this review focuses only on measurement of

outcomes during the application of the emotion regulation strategy or directly after the application. Theories of the construct of acceptance suggest that beneficial effects might be more apparent over the long term. Because none of the studies included demonstrated long term effects, conclusions cannot be drawn regarding long term effects.

4.8. Strength of the current study

To our knowledge, this is the first research report to systematically investigate the experimental effects of acceptance strategies in comparison with other emotion regulation strategies and to use meta-analytic tools to address these questions. Experimental research (and its synthesis) is needed because it is difficult to prove that a potentially effective treatment is superior to another effective treatment within therapeutic contexts. This is, so far, for several reasons: Different psychological treatments overlap due to common unspecific mediators (such as therapeutic relationship) and similarities between treatments, and it is almost impossible to disentangle these variables within treatment studies. Therefore, for certain research questions experimental designs investigating mechanisms have some advantages over complex treatment studies: in such experimental designs it is more likely that a result can be attributed to an underlying construct or unique strategy, because these experiments are conducted under controlled conditions. Moreover, if outcome differences between two powerful treatments are rather small, it is difficult to obtain statistically significant differences due to restricted sample sizes. It is easier to increase sample size to enhance statistical power in laboratory experiments than in treatment studies.

Moreover, meta-analyses have the advantage of being more stringent and less error-prone compared to qualitative reviews. However, the advantage of a systematic qualitative review is the ability to examine more aspects of the results, although it is possible that random-effects show up due to small sample sizes. The integration of both approaches is thus strength of this report.

Furthermore, this study sheds light on the much-discussed question of whether acceptance strategies lead to better outcomes than do traditional emotion regulation strategies such as suppression and distraction.

4.9. Implications for future research

Future research should address the question of *which conditions* influence the effects of each emotion regulation strategy. Studies should also look at the relationship between emotion regulation strategies on a *trait level* and acceptance and other emotion regulation strategies on a *state level* (Feldner et al., 2003; Forman et al., 2007; Kuehner et al., 2009; Levitt et al., 2004). If people are *trained in a particular strategy*, they might find it easier to apply a specific strategy in an experimental setting. This in turn may impact the effectiveness of the applied strategy.

Furthermore, little is known about applying different strategies within the whole *sequential process* of emotion regulation. Studies should investigate the application of acceptance strategies under various *situational and temporal conditions* (e.g. acceptance may be especially useful after reappraisal failed) (Hofmann & Asmundson, 2008).

As it is widely known that suppression is maladaptive as a long term strategy, studies should focus more on the comparison between acceptance strategies and other emotion regulation strategies that are frequently used in established treatments such as *reappraisal* (Forman et al., 2007; Hofmann et al., 2009).

Further studies should investigate the various emotion regulation strategies within *clinical samples* (e.g. within chronic pain populations).

4.10. Clinical implications

Acceptance strategies should be integrated into clinical treatments, because they appear to be as powerful as well-established strategies such as distraction and reappraisal. We recommend that acceptance strategies be applied especially in the field of chronic pain, because acceptance strategies appear to be more powerful as other emotion regulation strategies in increasing pain tolerance. Acceptance strategies should also be integrated in treatments that aim at reducing negative affect. Finally, we verified that strategies such as suppression and rumination are counterproductive in managing various emotional and cognitive states. Patients should be trained in replacing maladaptive strategies such as suppression and rumination with either acceptance or other adaptive strategies. Thus, we believe that acceptance strategies should be regarded as equally valuable compared to traditional CBT strategies.

4.11. Conclusion

The present meta-analytic review indicates that experimental acceptance strategies are especially effective in increasing pain tolerance. Acceptance strategies can change the way of responding to pain related thoughts and feelings and offer a broader scope of behavior, i.e. tolerating painful stimulation longer. Acceptance strategies were at least as effective as adaptive emotion regulation strategies such as reappraisal and distraction in decreasing pain intensity and negative affect. A general superiority of acceptance strategies compared to other emotion regulation strategies was not found. Future research should investigate which patients benefit the most from particular emotion regulation strategies.

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B: 2. Studie

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Acceptance, cognitive restructuring, and distraction as coping strategies for acute pain

Running head:

Strategies for acute Pain

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Abstract

Little is known about treatment mechanisms underlying acceptance strategies. Acceptance is a strategy that is expected to increase pain tolerance more than distraction, while distraction should lead to lower pain intensity. The effect of cognitive restructuring on experimental pain has not yet been investigated. The present study aimed to explore differential short-term effects of acceptance, distraction, and cognitive restructuring on pain tolerance and intensity. Pain was induced in a sample of 109 female students using a thermode. We conducted ANCOVAs with instruction as the independent variable and posttest scores on pain variables as dependent variables, co-varying for pretest scores. In addition, adherence to instructions and credibility of instructions were included as covariates. Acceptance led to a higher increase in pain tolerance than did cognitive restructuring of pain-related thoughts. No differences were detected between either acceptance and distraction or distraction and cognitive restructuring with respect to pain tolerance. Distraction led to lower pain intensity compared to acceptance. Cognitive restructuring did not differ from either acceptance or distraction with respect to pain intensity. As a short-term strategy, cognitive restructuring was not as useful as acceptance in increasing pain tolerance. Further studies should evaluate the preconditions under which different strategies are most effective.

Perspective: This study demonstrated that acceptance was superior to cognitive restructuring in increasing tolerance for experimentally-induced pain, but was inferior to distraction with respect to decreasing pain intensity.

Knowledge about the types of strategies that are useful in targeting diverse pain-related outcome measures is important for efforts to refine the treatment of chronic pain.

Keywords: acceptance; cognitive restructuring; distraction; pain tolerance; pain intensity; acute pain; short-term strategies

Introduction

Numerous studies have investigated the effects of acceptance-based interventions for chronic pain [37; 39; 40]. Although the theoretical concept of acceptance has existed for many years and has been extensively described by the developers of Acceptance and Commitment Therapy (ACT) [15], the mechanisms through which acceptance exerts its effects remain unclear. Furthermore, little is known about the relative efficacy of acceptance strategies compared to other strategies used in established treatments for chronic pain, such as distraction and cognitive restructuring.

Experimental studies are needed to better evaluate the mechanisms of these strategies. Therefore, the present study used an experimental design to compare various short-term coping strategies with respect to their effects on pain tolerance and pain intensity.

In the context of treatment for pain, acceptance is intended to disrupt the link between thoughts and behaviors such that participants are willing to tolerate painful stimulation for longer periods of time (despite negative thoughts and feelings) in order to pursue values-based activities. The majority of experimental studies support this hypothesis: an acceptance strategy has been shown to be more effective at increasing *pain tolerance* than were other pain regulation strategies, for example distraction or suppression [3; 12; 14; 23; 25; 30]. About half of the studies induced pain through thermal stimuli, and the remaining studies applied electrical stimulation. Only one study investigated influences on pain tolerance and intensity in a clinical sample. A meta-analytic review found a statistical advantage of acceptance strategies compared to other pain regulation strategies for pain tolerance [19].

Distraction aims to shift the attentional focus away from painful stimulation and thereby to lessen *pain intensity*. Some studies indicate that strategies such as distraction or suppression are more effective at reducing pain intensity relative to an acceptance strategy [3; 12; 30]. On the other hand, a meta-analytic review indicated that distraction and suppression were not superior to acceptance strategies with at reducing pain intensity [19].

In addition to distraction, cognitive-behavioral treatments (CBT) for chronic pain implement cognitive restructuring [17; 28]. Patients are trained to alter the appraisal of dysfunctional pain-related thoughts in order to improve coping with pain. Some studies also suggest influences of cognitive variables on pain intensity [4; 7]. Based on the theoretical assumptions of the CBT model, it appears that restructuring of pain-related thoughts may affect disability-related behavior such as withdrawing from painful stimuli. One study investigating anxiety found that a reappraisal strategy was more effective at reducing moderating the feeling of anxiety compared to an acceptance strategy, while for other outcome measures no significant differences were found [16]. A study on anger found a greater reduction in the reappraisal condition than in the acceptance condition, and participants in the reappraisal condition tolerated a frustration task longer than those in the acceptance condition [35].

To the best of our knowledge, no experimental study to date has compared the effects of acceptance, distraction and cognitive restructuring on pain tolerance and pain intensity.

Therefore, we aimed to investigate whether these strategies differentially affect pain tolerance and pain intensity.

Methods and Materials

Participants

An a priori power analysis was performed with G*Power 3.1.3. The power analysis indicated that given an effect-size of 0.3, three groups and two degrees of freedom, and three covariates, a sample of 111 participants was expected to be suitable for detecting main and interaction effects with a power of 0.8 and an alpha criterion of 0.05.

Participants were German first-year female undergraduate psychology students recruited through announcements at the Philipps-University of Marburg and via the internet. Students received course credit for participation. Exclusion criteria were male gender, chronic and acute pain conditions, Raynaud's disease, high blood pressure, neuropathy, coronary diseases, diabetes, insufficient knowledge of German language, and current pain medication use. We excluded male participants because several recommendations suggest investigating females, e.g. [11] due to the greater prevalence of pain conditions in women and differences in pain sensitivity. Furthermore, men and women differ in pain sensations [5; 34], and therefore including both genders could produce more subgroups or confounding variables. Moreover, we excluded men in order to prevent any interaction effect of experimenter gender and participant gender on pain tolerance [21]. We chose female experimenters to avoid potential influences of a cross-gender interaction.

Hundred and fifteen participants completed online questionnaires. Five participants were excluded due to pain medication intake, chronic or acute pain, or Raynaud's disease. 110 participants were randomly allocated to one of the three conditions: acceptance, distraction, or cognitive restructuring. One participant was excluded after randomization due to insufficient language skills (total N=109).

Participants' ages ranged from 19 to 30 years (M=22.1, SD=2.38).

The research project was approved by the Ethics Committee of The German Psychological Society (Deutsche Gesellschaft für Psychologie, DGPs, WR032010). Participants were informed of the procedure and had the opportunity to withdraw from the study at any time.

Study design

A mixed between-within design with three factors was employed. The between-group factor was instruction condition (acceptance, distraction, and restructuring). The within-group factor was time point (pretest vs. posttest).

Procedure

Self-report measures

All participants completed three questionnaires assessing habitual coping strategies corresponding to the three different instructions in order to test whether group differences existed in habitual coping strategies due to unsuccessful randomization.

Questionnaires were completed at home prior to the experimental session. Habitual cognitive restructuring of pain-related thoughts and mental distraction from pain-related thoughts were assessed using the Coping Strategies and Pain-Related Distress Questionnaire (FESV; Cronbach's α=0.77, test re-test reliability=0.79) [9]. An example item assessing cognitive restructuring is, "When I am in pain, I say to myself that because of pain, I learn to appreciate painless conditions," While an example item assessing mental distraction is, "When I am in pain, I distract myself by listening to good music." Habitual acceptance of pain was measured using a questionnaire created by the authors with 10 items rated on a five-point Likert scale. Items were generated by adapting items from the Chronic pain acceptance questionnaire [24; 29], the Acceptance and Action Questionnaire (AAQ II) [2], and the Difficulties in Emotion Regulation Scale (DERS) [10]. Items were reformulated to refer to pain conditions and to be appropriate for use in healthy samples ("I accept when I am in pain" or "I do a lot of activities when I am in pain"). Furthermore, consultation with experts in the field of acceptance-based treatments as well as pain suggested that the questionnaire has high face validity. Each item was also discussed within our working group. Participants also completed the DERS and the AAQ II in order to validate the newly created questionnaire. Data for these measures are not reported within this article because these questionnaires were not used in analyses. The measure of habitual coping strategies showed good internal consistency (Cronbachs α=0.76), was significantly correlated with measures of similar constructs such as the AAQ II (r=0.39; p<0.01) and the Non-Acceptance subscale of the DERS (r=-0.3; p<0.01), and was not significantly correlated with measures of theoretically distinct constructs such as the cognitive restructuring subscale of the FESV (r=0.06; p=0.55) and the mental distraction subscale of the FESV(r=-0.02, p=0.8).

In addition, participants completed the German version of the Beck Depression Inventory (BDI-II) [13] and the Pain Sensitivity Questionnaire (PSQ; Cronbach's α=.92, test re-test reliability=.83) [33], in which respondents rate the degree of pain associated with various scenarios (e.g., "Imagine you burn your tongue on a very hot drink")on an eleven-point Likert scale. We also assessed level of pain catastrophizing using the German Version of the Pain Catastrophizing Scale (PCS; Cronbach's α=.92) [27]. An example item is, "I worry all the time about whether the pain will end."

Estimates of internal consistency and reliability ratings are drawn from prior research, with the exception of the data from the questionnaire designed by the authors (habitual acceptance of pain).

Pretest

Two different female experimenters conducted the experimental sessions. Participants signed an informed consent form, were given the opportunity to ask questions, and were informed about the procedure and the application of the thermode. Before the pretest, participants had the opportunity to familiarize themselves with the procedure and to practice stopping the heat stimulus.

Participants underwent the same assessment twice: pain tolerance and pain intensity were measured at pretest and at posttest.

Stimulus material and outcome measures

We employed thermal stimuli between 32°C and 50°C to induce pain. Stimuli were delivered to the dominant forearm via a 3 x 3 cm peltier-based thermode (TSA II: Thermal Sensory Analyzer, Medoc Ltd, Israel). The thermal stimulus started at 32°C and rose with a slope of 0.5°C per second. The thermode remained at the same place on the skin for pretest and posttest. Participants were asked to tolerate stimuli as long as possible and to stop the stimulus by clicking a computer mouse. Pain tolerance was determined by the temperature at which the participant stopped the thermal stimulus. When the maximum temperature was reached, the software automatically returned the thermode to the baseline temperature of 32°C.

Pain intensity was assessed with a 10 cm visual analogue scale (VAS) immediately after the termination of each thermal stimulus. The minimum anchor was 'no pain' and the maximum anchor was 'worst imaginable pain.'

Instructional Set

Participants listened to one of the three instructions via headphones. Instructions were based on those used in several prior studies [12; 31; 32; 38]. All instructions were approved by several experts on pain treatments, mindfulness based treatments, and CBT. Several pilot tests were conducted and instructions were modified after each trial according to experts' ratings.

All instructions were approximately the same length (5.5 minutes) and followed the same structure: participants were asked to write down three thoughts that had led to termination of pretest stimuli in order to work on these thoughts using the specific strategies. Next, a description of the strategy was given, followed by an example of successful application of the strategy (a painful situation at a dentist's office was used as an example). Participants were given the opportunity to practice the strategy before the concrete instructions for the second trial (posttest) were provided.

Acceptance Instruction: it was explained that thoughts often initiate behavior, but that it is also possible to disengage oneself from these thoughts (defusion) through non-judgmental awareness (mindfulness) or acceptance. The strategy of regarding thoughts as clouds in the sky was discussed as an example of defusion. If thoughts can be accepted, they no longer control behavioral tendencies and do not inhibit personal goals. Within the exercise, participants were asked to imagine that they were experiencing the thermal stimulus and to regard their thoughts as clouds in the sky passing by.

Cognitive Restructuring Instruction: It was explained that thoughts, feelings, and actions are related. It is possible to alter the appraisal of a situation so that feelings and behavior tendencies also change according to the reappraisal. Negative and dysfunctional thoughts can be replaced by more functional ones, and the new point of view results increased freedom of action. Within the exercise, participants were asked to imagine the application of the thermode and to develop alternative thoughts such as,

“this painful experience does not mean that my skin will be damaged” or “tolerating pain is a challenge and I have already overcome worse pain.”

Distraction Instruction: It was explained that distraction can lead to reduced perception of thoughts and feelings. Attention can work like a spotlight: depending on which thoughts and feelings come into focus, other thoughts and feelings may be “blanked out.” It is possible to distract oneself internally or externally. Internal distraction may take place via imagination or recalling past experiences, while external distraction may involve increasing attention to environmental stimuli. Within the exercise, participants were asked to imagine feeling the heat stimulus and to distract themselves by imaging a pleasant scene.

For further details see the Appendix.

Posttest

Following the instructions (approximately six minutes after pretest), the heat stimulus was applied again. Participants stopped the thermal stimulus by a mouse click when no longer willing to tolerate it and were asked to rate pain intensity on the VAS afterward.

Manipulation check and pain threshold

After the posttest, participants received a manipulation check questionnaire assessing the extent to which the instructions were applied (rated as a percentage). Participants also rated the credibility of the instructions on a four-point scale ranging from ‘very much’ to ‘not at all.’

Furthermore, pain thresholds were determined by the mean value of three trials for the heat stimulus, in which participants were instructed to stop the stimulus when it became painful. The interstimulus interval between each of the trials was set to four seconds. Pain threshold was determined after pretest and posttest assessment of pain tolerance and intensity in order to avoid habituation to the heat stimulus.

Results

Statistical Analysis

Three participants were able to tolerate the maximum of heat of 50°C during the pretest, and were excluded from further analyses of pain tolerance. We also excluded one outlier with pain tolerance levels for both pre- and posttest that were > 2.5 SD below the mean pain tolerance level (see Table1). All analyses were performed using the Statistical Package for Social Sciences (SPSS, Windows Version 19).

Table 1. Outlier analysis

Ceiling effects	**Condition**	**BDI**[a]	**PSQ**[b]	**PCS**[c]	**FESV-KU**[d]	**FESV-MA**[e]	**Pain acceptance**[f]	**DERS-Nonacc.**	**AAQ**
No.1	Distraction	2	4.14	28	5	10	28	16	58
No.2	Restructuring	18	3.86	32	7	8	29	8	48
No.3	Distraction	8	3.21	20	10	10	34	19	55
Outlier +/- 2.5 SD									
No.1	Acceptance	4	2.14	27	7	16	23	6	52

[a] Beck Depression Inventory II
[b] Pain Sensitivity Questionnaire
[c] Pain Catastrophizing Scale
[d] FESV, cognitive restructuring subscale
[e] FESV, mental distraction subscale
[f] Pain Acceptance Questionnaire

To assess the differential effects of instructions on pain tolerance and pain intensity, we performed separate analyses of covariance (ANCOVA) for each outcome measure with instruction condition as the independent variable, posttest data as the dependent variable, and pretest data as a covariate. In these ANCOVAs, we also controlled for the information gathered via the manipulation check (the percentage rating of adherence to instructions and the rated credibility of the instructions). We assumed the instructions to be more powerful when rated as more credible. Post hoc pairwise comparisons were performed to identify differences between the three types of instructions.

Baseline characteristics

No significant differences were found in any of the baseline measures (e.g., age or self-report measures); thus, we concluded that the randomization was successful. For further details see Table 2. There were no significant effects of experimenter on outcome measures.

Table 2. Sample characteristics

	Acceptance (n=38)	Distraction (n=36)	Cognitive restructuring (n=35)	F-Value[h]
Age (mean, SD)	22.53 (2.28)	21.39 (1.83)	22.43 (2.84)	2.624
BDI [a] (mean, SD)	8.71 (6.79)	11.39 (8.43)	9.31 (8.77)	1.123
PSQ [b] (mean, SD)	3.40 (1.18)	3.35 (0.92)	3.25 (1.05)	0.190
PCS [c] (mean, SD)	24.63 (7.87)	24.39 (8.72)	22.4 (10.37)	0.66
Room temperature (mean, SD)	24.36 (3.84)	23.72 (3.52)	24 (4.04)	0.258
Pain acceptance [d] (mean, SD)	30.61 (5.94)	30.33 (5.45)	29.57 (5.19)	0.336
FESV-cognitive restructuring [e] (mean, SD)	12.05 (3.35)	13.31 (3.99)	12.6 (3.45)	1.12
FESV-mental distraction [f] (mean, SD)	15.18 (4.81)	13.33 (5.09)	14.09 (3.58)	1.549
Pain threshold (mean, SD) [g]	44.13 (3.24)	43.50 (2.68)	43.87 (2.73)	0.437

[a] Beck Depression Inventory II
[b] Pain Sensitivity Questionnaire
[c] Pain Catastrophizing Scale
[d] Pain Acceptance Questionnaire
[e] FESV, cognitive restructuring subscale
[f] FESV, mental distraction subscale
[g] Pain threshold was assessed after posttest
[h] all F-values are non-significant ($p > 0.05$)

We explored whether adherence to instructions differed across groups using an ANOVA with instruction group as the independent variable and adherence to instructions as the dependent variable. Significant group differences were found [$F(2, 106) = 3.48$, $p < 0.05$]. Pairwise post-hoc analyses indicated that participants in the distraction condition showed higher adherence to instruction compared to those in the acceptance ($p < 0.05$) and cognitive restructuring ($p < 0.05$) conditions, while acceptance and cognitive restructuring did not differ ($p = 0.731$) (see Table 3).

Table 3: Means and standard deviations of adherence to instructions ratings for the three conditions

Adherence	Mean (SD)	F (2, 106) = 3.48, $p < 0.05$
Acceptance	68.16 (23.29)	
Cog. Restructuring	69.83 (22.5)	
Distraction	80 (15.31)	

Furthermore, we calculated an ANOVA to test whether instruction conditions differed with respect to credibility. The effect was non-significant [$F(2, 106) = 2.16$, $p = .121$] (see Table 4).

Table 4: Means and standard deviations for credibility ratings for the three conditions

Credibility	Mean (SD)	F (2, 106) = 2.16, $p = 0.121$
Acceptance	2.11 (0.65)	
Cog. Restructuring	1.91 (0.66)	
Distraction	1.81 (0.58)	

Pain tolerance

Means and standard deviations for pain tolerance (temperature in °C) at pretest and posttest for the three conditions are shown in Table 5.

Table 5. Means and standard deviations for pretest and posttest for pain tolerance

Pain tolerance (°C)	**Acceptance** (n = 37)	**Distraction** (n = 34)	**Cognitive restructuring** (n = 34)
Pretest	44.91 (3.02)	44.79 (2.55)	44.46 (2.54)
Posttest	47.38 (2.14)	46.97 (1.61)	46.63 (2.22)
Estimated Marginal Means [a]	47.34 (0.17)	46.87 (0.18)	46.77 (0.17)

[a] Standard errors in parentheses

The ANCOVA identified a significant effect of instruction condition on pain tolerance at posttest [$F(2, 99) = 3.2$, $p < 0.05$], when controlling for pretest scores. Pair-wise post-hoc analyses indicated that acceptance was significantly more effective than cognitive restructuring at increasing pain tolerance ($p < 0.05$). Pain tolerance at posttest did not differ between the acceptance and distraction conditions ($p = 0.058$) or between the distraction and cognitive restructuring conditions ($p = 0.692$) when controlling for pretest scores (see Figure 1). In sum, instructions to accept thoughts and feelings related to painful stimuli prolonged the tolerance of these stimuli relative to an instruction to cognitively restructure pain-related thoughts and feelings. In addition, there was also a trend for acceptance to be superior to distraction in increasing tolerance for thermal stimuli.

The effect of the covariate 'pretest' was also significant [$F(1, 99) = 316.7$, $p < 0.01$]. This finding indicates that pretest and posttest data were highly correlated.

In addition to the main effects for instruction condition and for pretest, credibility of instructions was significantly related to posttest scores [$F(1, 99) = 10.49$, $p < 0.01$]. The interaction between credibility and instruction condition was non-significant.

A post-hoc analysis revealed a significant partial correlation between credibility and pain tolerance at posttest ($r = 0.25$, $p < 0.05$), when controlling for pain tolerance at pretest.

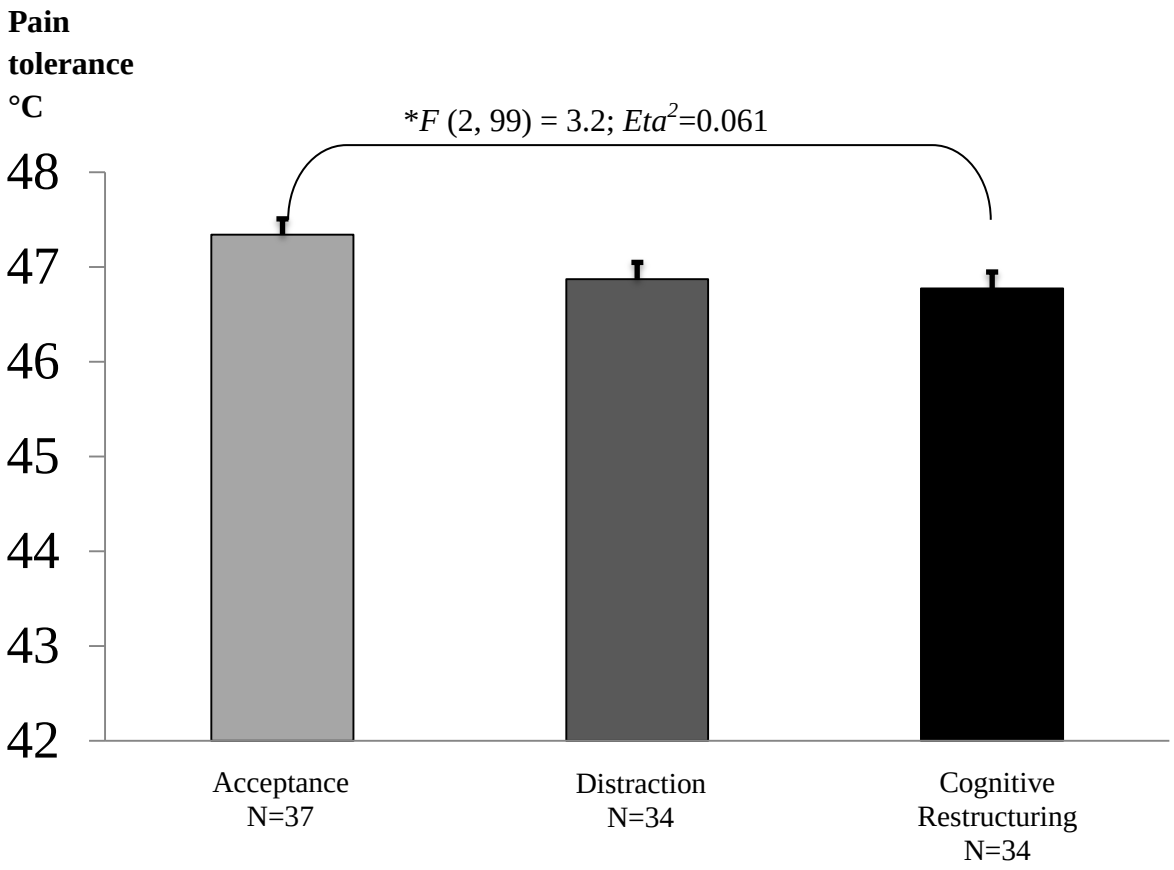

Figure 1. Estimated Marginal Means and standard errors for pain tolerance (assessed in the range between 32°C and 50°C)

Pain intensity

Table 6 shows means and standard deviations for pain intensity (VAS) at pretest and posttest for the three instruction conditions. Examination of means indicated that pain intensity increased during posttest compared to pretest scores.

Table 6. Means and standard deviations for pretest and posttest for pain intensity

Pain intensity (VAS)	**Acceptance** (n = 38)	**Distraction** (n = 36)	**Cognitive restructuring** (n = 35)
Pretest	68.63 (15.62)	60.39 (16.18)	59.80 (16.59)
Posttest	78.39 (14.90)	65.33 (16.82)	67.34 (17.32)
Estimated Marginal Means [a]	74.33 (1.75)	67.16 (1.78)	69.88 (1.79)

[a] Standard errors in parentheses

Controlling for pretest scores, the ANCOVA showed a significant effect for instruction condition on pain intensity from pretest to posttest [$F(2, 103) = 3.97$, $p < 0.05$]. Post-hoc pair wise comparisons

indicated significant differences between acceptance and distraction ($p < 0.01$), favoring distraction. In other words, participants who received the distraction instructions had lower pain ratings compared to participants who were instructed to accept painful thoughts and feelings. No significant differences in posttest pain intensity were found between the acceptance and cognitive restructuring conditions ($p = 0.098$) or the cognitive restructuring and distraction conditions ($p = 0.244$) when controlling for pretest scores (see Figure 2).

Moreover, the effect of the covariate 'pretest' was significant [$F(1, 103) = 155.26$, $p < 0.01$], indicating that pretest and posttest data were highly correlated.

Credibility of instructions was not significantly related to posttest pain intensity [$F(1, 102) = 0.013$, $p = 0.908$].

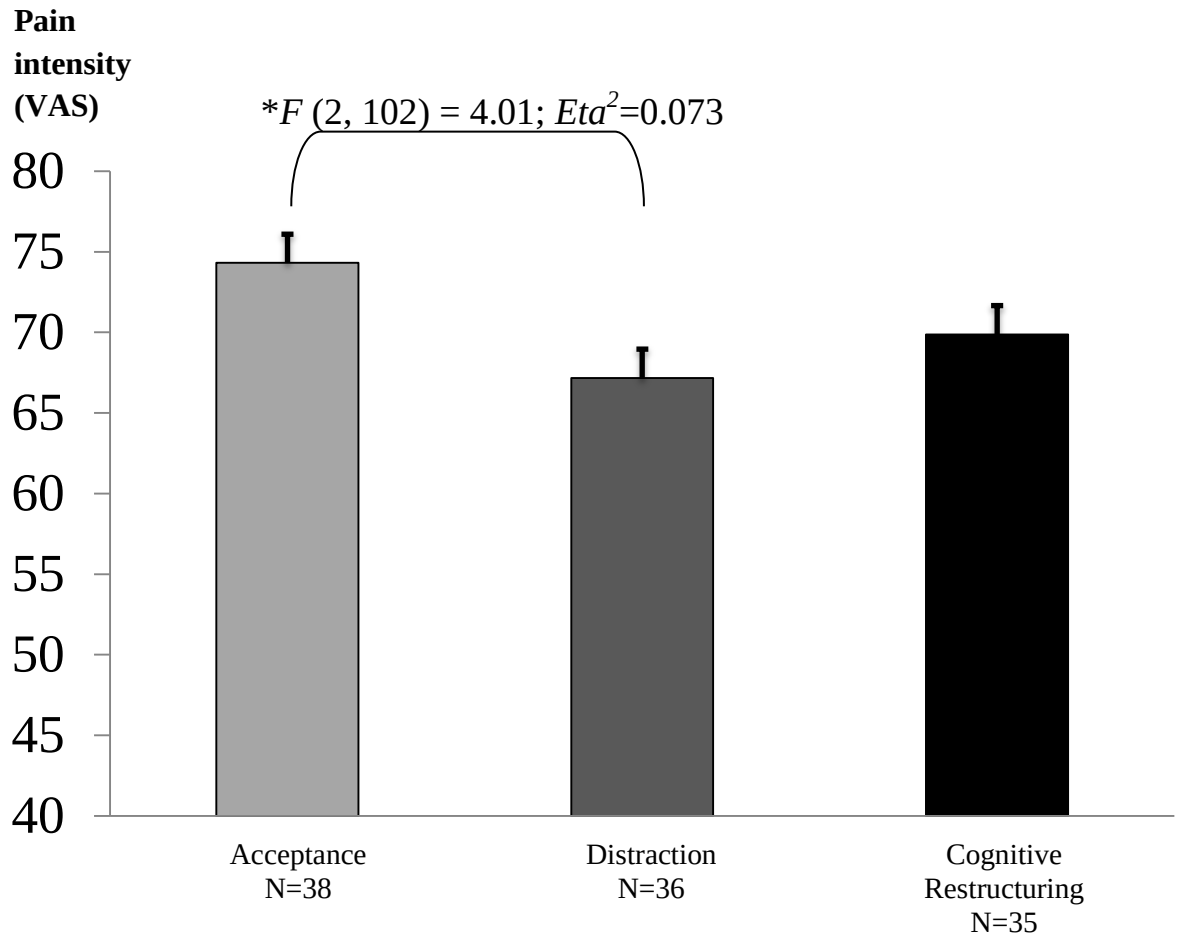

Figure 2. Estimated Marginal Means and standard errors for pain intensity assessed by the visual analogue scale ranging from 'no pain'=0 to 'worst imaginable pain'=100

Discussion

The present study investigated the effects of different short-term pain regulation strategies (acceptance, distraction, and cognitive restructuring) on experimentally induced heat pain tolerance and pain intensity. We found that acceptance led to increased pain tolerance relative to cognitive restructuring. Distraction led to lower pain intensity compared to acceptance.

Pain tolerance

Tolerance time went up for all participants across the instructional sets. We found that acceptance was more effective at increasing pain tolerance than was cognitive restructuring, with a medium effect size. Previous studies have also shown that acceptance is especially effective when participants perceive high discomfort during experimental pain procedures [12; 30]. For instance, a prior experimental study of food cravings found that acceptance was only superior to cognitive restructuring among participants reporting a high susceptibility to food [8].

We considered the possibility that the ineffectiveness of cognitive restructuring might have been due to an insufficient level of pain catastrophizing in healthy volunteers. Interestingly, our results indicate that the mean value of pain catastrophizing was higher than in another study with low back pain patients [26].

Nevertheless, although participants endorsed relatively high levels of pain catastrophizing in a questionnaire, the experimental pain might have not been sufficient to provoke catastrophizing in this particular situation.

Our results contrast with those of previous studies of coping strategies for anxiety and anger [16; 35]. However, comparisons between anxiety or anger and pain tolerance are limited, because pain tolerance is a behavior and anxiety and anger are experiences.

Differences between the present and prior results may have occurred due to the use of different outcome measures or because the instructions differed in content. In addition, some studies have suggested that acceptance strategies may have the greatest impact when the strategy is embedded in a values-based context [3; 30] or when acceptance instructions involve metaphors and exercises [25], such as the present study's use of the example of thoughts as clouds in the sky.

No significant differences were detected between distraction and acceptance with respect to pain tolerance. Our results are in line with those of a previous study that also failed to find significant differences between acceptance and distraction [18], but run counter to the results of another study that found that acceptance was superior to distraction at increasing pain tolerance [12]. Our findings are also consistent with the results of a recent meta-analysis indicating that acceptance strategies appear to be more effective than other strategies at increasing pain tolerance [19]. When acceptance was compared to control groups which are considered less powerful, such as suppression [23; 30], or to conditions that did not involve one specific strategy, significant differences were more easily detected [3; 14; 32].

With respect to pain tolerance, we can draw the preliminary conclusion that cognitive restructuring is no different from distraction in increasing pain tolerance.
Interestingly, we found that credibility had an effect on the extent of pain tolerance, with higher credibility of instructions accompanied by greater tolerance for painful stimuli.
To summarize, acceptance strategies can change the way of responding to pain-related thoughts and feelings and offer a broader scope of behavior. Cognitive restructuring does not appear to change pain-related behavior as much as acceptance, although it can be an important tool for other clinically relevant experiences, i.e. anxiety or anger.

Pain intensity

In line with a previous study [12], distraction proved to be more effective than acceptance with respect to pain intensity ratings, with a medium effect size. Because acceptance strategies do not seek to alter inner experiences, it is reasonable that an acceptance strategy did not impact a sensory nociception. Previous studies comparing the effects of acceptance versus distraction or suppression on pain intensity have yielded mixed findings [3; 18; 25; 30; 31], and a meta-analysis found no significant differences in the effects of acceptance and other pain regulation strategies on pain intensity [19]. Divergent results may have emerged due to different operationalizations of constructs in the instructions or type of comparison condition. Distraction was not more effective than cognitive restructuring at regulating pain intensity in the present study.
In line with the results of a previous study, pain intensity increased from pretest to posttest across all groups [32]. It is possible that the skin surface becomes sensitized to additional exposure to warm stimuli, such that participants perceived stimulation as more painful at posttest.

It is not surprising that the acceptance group had the highest pain ratings, because participants in this group tolerated stimuli for a longer period of time than participants in the other two groups. We suggest that pain intensity and pain tolerance are based on a common latent factor and therefore, we decided not to co-vary either pain tolerance or pain intensity in analyses of the other.

Advantages of this study

This is the first study to test the effects of different coping instructions within a highly standardized thermal pain induction procedure. Previous studies have not compared acceptance strategies with cognitive restructuring in the context of experimentally-induced pain. The sample size in our study was larger than in most of the other studies, and was adequately powered to detect significant differences. Moreover, we assessed potential pre-existing differences in habitual coping strategies and tested the credibility of our manipulation and the degree of adherence to instructions. Results highlight the importance of experimental research investigating mechanisms of therapeutic interventions. The

present study indicated that differences emerge between short-term strategies, and that advantages of simple and unique strategies should be better disentangled.

Limitations

The generalizability of our results to males might be limited because of gender-specific effects on pain threshold and pain tolerance [5; 18; 34]; in addition, results might not generalize to other age cohorts due to the restricted age range. Generalizability to chronic pain patients may also be limited. Pain stimuli might have a different meaning or affective valence for chronic pain patients than to a sample of students, and it is unclear to what extent experimentally-induced pain is comparable to chronic pain conditions. Nevertheless, conducting a study with healthy participants to detect patterns in pain behavior and pain sensations independently of chronic conditions represents an important initial step.

Because participants' level of catastrophizing was relatively high, the cognitive restructuring instruction might have been insufficient to significantly reduce the level of catastrophizing. Cognitive restructuring is a very complex strategy that requires practice, and the instructions within the present study lacked some elements of cognitive restructuring such as rational rebuttal to automatic thoughts. On the other hand, experimental studies with even shorter reappraisal instructions have shown beneficial effects [16; 35].

Furthermore, distraction was associated with greater adherence to instruction than cognitive restructuring or acceptance. Distraction may be the most commonly known strategy for coping with pain. Therefore, people might find it easier to apply such a strategy. This point adds weight to the argument that cognitive restructuring and acceptance might require more training to optimize effectiveness.

One might argue that the lack of a control condition is another limitation. However, several studies have already demonstrated the effectiveness of strategies such as distraction and acceptance in comparison to a control group [1; 19]. In line with the rationale for RCTs, which allows the comparison of new treatments to established ones without a control group, we decided not to include a control group.

Another limitation of our study is that the procedure did not allow all participants to reach the limit of their pain tolerance, because the thermode stops at 50°C for ethical reasons. However, we were able to include more than 95% of participants in analyses for heat pain tolerance.

Some research suggests that previous knowledge about a specific coping strategy might influence the adequate application of this strategy [6; 8; 20; 22]. It should be noted that our study is not a comparison between ACT and CBT, because we tested only isolated strategies from a larger 'toolbox' for both treatment types.

Clinical implications

Although it is difficult to translate the present results into clear clinical recommendations for chronic pain patients, we know that the willingness to tolerate pain for longer periods of time is crucial for chronic pain patients. Attempting to avoid pain results in disability, reduced participation in daily life activities, and lower functioning. Furthermore, chronic pain patients suffer enormously from pain and therefore may benefit from strategies that lead to reduced pain intensity. Thus, it is useful to know that distraction may be more helpful than acceptance in decreasing the nociceptive sensation of pain, and that cognitive restructuring seemed to be as useful as distraction. In sum, we recommend applying a range of strategies for managing chronic pain in order to influence both pain tolerance and pain intensity. The fact that credibility of instructions was related to outcome variables demonstrates the importance of presenting strategies convincingly, and suggests that it might be beneficial to allocate patients to the treatments they rate as the most credible.

Implications for future research

Future studies should evaluate the usefulness of the various coping strategies at modifying a wider range of clinically relevant outcome variables. Expectancies may be important moderators of treatment outcomes [36], and our findings indicate the importance of assessing this variable within experimental and clinical trials, especially in trials of procedures that aim to alter behavior. We recommend assessing credibility immediately after the instructions rather than after posttest, because experiences during posttest might influence credibility ratings.

Future research should address whether different instructions are associated with different effects within chronic pain populations, and further studies are needed to draw conclusions about long-term effectiveness of the various strategies.

The majority of research in this field is conducted with healthy participants, such that replicating results in clinical samples is a priority. Furthermore, it is important to investigate the circumstances under which particular strategies are most effective for different target variables.

Disclosure

There is no actual or potential conflict of interest for any of the authors. The study was funded by Philipps-University of Marburg.

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Appendix

Complete Instructions

1. *Acceptance*: Please list three different thoughts which urged you to stop the painful stimulus. *(break of 1 minute)*

Now I would like you to put down your pencil. *(short break)*

Sometimes our thoughts control our behavior. However this connection between thoughts and actions can be loosened. Sometimes it is even very important to ignore our thoughts if we want to achieve our goals. It is a good strategy to merely perceive your thoughts without judging or changing them. You may think of thoughts like clouds in the sky. If you do not regard your thoughts as to be of importance but just observe them, they will pass by like clouds in the sky. The acceptance of unpleasant thoughts may lead to different actions than your thoughts wants you to act. Thus your thoughts do not control your life because they are not the cause of your behavior, and because it is important to pursue certain goals.

Example: Imagine one of your last visits to the dentist. Maybe at one of those visits you had to experience pain. However you have accepted the pain because you pursued the goal to preserve your teeth as long as possible. Maybe there have been thoughts which urged you to stop the treatment. And maybe you have not conceded them spontaneously but just noticed and accepted them, and finally let them go. Thus you just kept sitting there and endured the pain.

Exercise: Please read again through your thoughts which urged you to stop the stimulus. Close your eyes and imagine the thermode is causing you pain again. Try to perceive these thoughts neutrally and let them pass by like clouds in the sky. Please note that you are able to act independently of your thoughts if you merely perceive your thoughts without any judgments. (*break of 1 minute)*

Specific instruction: Now I would like you to open your eyes. Please try to increase the duration of the hot and cold stimulus by accepting all your thoughts and sensations. Let go of the thoughts you had in the beginning which urged you to stop the stimulus. Be ready to experience the pain without any attempt to change them.

2. *Distraction*: Please list three different thoughts which urged you to stop the painful stimulus. *(break of 1 minute)*

Now I would like you to put down your pencil. *(short break)*

If you try to distract yourselves from these thoughts you might perceive them less intense than before. Sometimes you have to distract yourself from disturbing influences in order to achieve your goals. Our attention works like a spotlight. Depending on which thoughts and feelings come into focus, other thoughts and feelings are blanked out. Thus we are able to shift our attention to other aspects to avoid unpleasant thoughts and feelings. On the one hand you are able to distract yourself internally, for example by recalling a pleasant situation. On the other hand you are able to distract yourself externally, for example by concentrating on your environment.

Example: Imagine one of your last visits to the dentist. Maybe at one of those visits you had to experience pain. To endure this pain, you possibly concentrated on a painting on the wall. Perhaps you even tried to look at that painting very closely in order to use your attention to capacity. And maybe in

your thoughts you planned the rest of the day and were thinking about the things you can do after your visit at the dentist. By means of the distraction you were able to cope with the treatment.

Exercise: Please read again through your thoughts which urged you to stop the stimulus. Close your eyes and imagine the thermode is causing you pain again. Imagine you are lying on a lawn on a warm summer day. You are watching other people who are lying on the lawn as well, looking at the clouds und listening to the singing birds. Try to imagine this scene and distract yourself from the thoughts which have urged you to stop the stimulus. *(break of 1 minute)*

Specific Instruction: Now I would like you to open your eyes. Please try to increase the duration of the hot and cold stimulus by distracting yourself from all your thoughts and feelings. Imagine the scene where you are lying on a lawn. Thus you may distract yourself from the pain and the thoughts which urge you to stop the stimulus.

3. *Cognitive* r*estructuring*: Please list three different thoughts which urged you to stop the painful stimulus. *(break of 1 minute)*

Now I would like you to put down your pencil. *(short break)*

Sometimes it helps to view a situation from a different angle and to develop another point of view. Depending on how we judge a certain situation, we show different feelings and behavior tendencies. On the one hand negative thoughts and appraisals may cause dejection and uncertainty, and may influence bodily sensations in a negative way. On the other hand positive thoughts may cause pleasant bodily sensations. Thus the same situation can lead to completely different appraisals. The way you feel and the way your body responds depends on how you judge the situation. Unpleasant thoughts can be replaced by helpful thoughts. As a consequence you act differently depending on your point of view.

Example: Imagine one of your last visits to the dentist. Maybe at one of those visits you had to experience pain. And maybe you viewed the pain from another point of view: For example, you were thinking that you have to endure just a little pain in order to avoid much worse pain in the future, and that the dentist knows what he is doing. Or perhaps you took the pain as a challenge and were thinking that you can be proud of yourself if you master this challenge.

Exercise: Please read again through your thoughts which urged you to stop the stimulus. Close your eyes and imagine the thermode is causing you pain again. Now you may develop alternative points of views. For example you may think something like “I have already overcome worse pain”, or “this painful experience lasts just a short period of time, compared to all the things I will be doing afterwards”, or “this pain is unpleasant but does not indicate any serious injury”. Maybe you come up with even more revaluations. *(break of 1 minute)*

Specific Instruction: Now I would like you to open your eyes. Please try to increase the duration of the hot and cold stimulus by developing another point of view of the pain. Please restructure your thoughts to alternative and helpful thoughts which will make it easier for you to endure the pain. You may use the thoughts you just developed.

C: 3. Studie

Kohl, A., Rief, W., & Glombiewski, J. A. (submitted). **Do fibromyalgia patients benefit from cognitive restructuring and acceptance? An experimental study.**

Full title:

Do fibromyalgia patients benefit from cognitive restructuring and acceptance?
An experimental study

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The manuscript entails six tables, four figures and 28 pages.

Abstract

The aim of this study was to clarify mechanisms of psychological fibromyalgia treatment by experimentally examining the effectiveness of its core elements. We assessed the effects of cognitive restructuring and acceptance on experimentally-induced heat and cold pain tolerance and pain intensity in fibromyalgia patients.

Cold and heat pain were induced in a sample of 60 fibromyalgia patients using a thermode. We conducted ANCOVAs to examine group differences in posttest scores, co-varying for pretest scores. The between-groups factor was the type of instruction provided (acceptance, cognitive restructuring, and a control condition). In addition, we controlled for pain sensitivity, age, and depression.

We found that acceptance and cognitive restructuring were superior to the control condition in increasing heat pain tolerance, but did not differ from one another. With respect to cold pain tolerance, cognitive restructuring was associated with increases in cold pain tolerance compared to the control condition, while acceptance did not differ either from the control condition or from cognitive restructuring. Responder analysis for pain intensity showed that the acceptance and cognitive restructuring instructions were helpful in reducing acute pain intensity by more than thirty percent. We found that high pain sensitivity was negatively associated with successful application of the cognitive restructuring instructions, but was not associated with application of acceptance instruction.

Results suggest a small advantage of cognitive restructuring over acceptance for enhancement of pain tolerance in fibromyalgia patients. Further experimental research on chronic pain treatment mechanisms is needed, particularly research on individually tailoring treatment strategies according to patients characteristics.

Key words: Acceptance; cognitive restructuring; fibromyalgia; short term strategies; experimental pain

Introduction

Fibromyalgia is a chronic pain syndrome characterized by widespread pain [56]. Psychological treatment of fibromyalgia is challenging, and its efficacy is unclear, as indicated by the fact that two recent reviews on treatment for fibromyalgia came to contradictory conclusions [1; 16]. Glombiewski and colleagues concluded that psychological interventions may lead to small changes in fibromyalgia pain, depression, catastophizing, and sleep. Bernardy and colleagues, however, concluded that cognitive behavioral treatment (CBT) did not influence fibromyalgia pain. This is rather surprising since CBT is known to be effective at lowering pain intensity for other pain syndromes [16; 23]. Clearly, more studies are needed to clarify the efficacy of psychological treatments for fibromyalgia.

When treatment studies and reviews, do not provide a clear conclusion, it is necessary to take a step back and examine the unanswered questions using experimental designs to trace results to underlying constructs or unique strategies. Therefore, we designed an experimental study to further examine the influence of CBT interventions on pain in fibromyalgia patients.

Fibromyalgia patients report differences in pain intensity, lower pain threshold, lower pain tolerance, and augmented pain processing relative to healthy controls [4; 14; 17; 25; 54]. Patients with fibromyalgia have also been shown to have lower pain tolerance and greater vigilance to pain compared to other chronic pain patients [5; 36]. In addition, fibromyalgia patients differ from healthy participants with respect to pain sensitivity for thermal and pressure pain paradigms [41]. High experimental pain sensitivity is also a risk factor for poor treatment response [8; 18]. Accordingly, we expected thermal stimuli to be similar to these patients' usual pain sensations and therefore to result in high external validity.

Cognitive restructuring is a core component of CBT for chronic pain [27; 39]. Even outside of fibromyalgia research, surprisingly little is known about the relative efficacy of cognitive restructuring, acceptance, and control conditions for pain tolerance and pain intensity [30]. Only one experimental study has investigated this topic, and this study included only healthy volunteers [29]. This study found that an acceptance strategy was more effective at increasing pain tolerance than cognitive restructuring, while no group differences were found in effects on pain intensity.

Acceptance is also an effective psychological intervention for chronic pain patients [42; 52]. In line with the underlying theory of Acceptance and Commitment Therapy (ACT) [22], results from experimental studies on acceptance have demonstrated that acceptance strategies increase pain tolerance more than other strategies such as distraction or suppression [2; 26; 31]. With respect to reducing pain intensity, studies have indicated that acceptance is inferior to other pain regulation strategies such as distraction [2; 19; 43].

However, low external validity due to inclusion of only healthy participants is a major shortcoming of this body of research. To our knowledge, this is the first study to compare the effects of a cognitive restructuring strategy, an acceptance strategy, and a control condition on pain intensity and pain tolerance among fibromyalgia patients [30]. Furthermore, we were interested in testing whether pain sensitivity affects response to instructions.

Methods

Participants

Participants were fibromyalgia patients (ICD 10: M79.7) recruited through announcements in regional newspapers, in pain doctors' offices, and pain clinics, on official notice boards, and in pharmacies. Fibromyalgia self-help groups were also contacted and provided with information about the study. Patients received 25 Euros for participation. Exclusion criteria were Raynaud's disease, high blood pressure, neuropathy, coronary diseases, diabetes, drug intake, and insufficient knowledge of German language.

Sixty-two patients participated in the study. Only two of the participants were male (3%) and were therefore excluded from analyses because a statistical control for gender would not have been possible. Furthermore, prevalence of fibromyalgia is almost seven times higher in women than in men [55], and in two prior studies 86% and 100% of fibromyalgia patients were women, respectively [53]; [33]. Participants were randomly assigned to one of the three conditions: acceptance, cognitive restructuring, or the control condition.

Participants' ages ranged from 24 to 65 years (M=51.4, SD=9.4).

The study was approved by the Ethics Committee of the Department of Psychology, Philipps-University of Marburg (2011-18K). Participants were aware of the procedure and had the opportunity to withdraw from the study at any time.

Study design

A mixed between-within design with three factors (acceptance, cognitive restructuring, and control) was used. The between-group factor was *instruction condition* (acceptance, cognitive restructuring, and control), and the within-group factor was *pretest* vs. *posttest*.

Procedure

Self-report measures

All participants completed two questionnaires assessing habitual coping strategies corresponding to the two different instruction conditions in order to control for possible group differences. Questionnaires were completed at home prior to the experimental session. Habitual *cognitive restructuring* of pain-related thoughts was assessed by the Coping Strategies and Pain-Related Distress Questionnaire (FESV; Cronbach's α=0.77, test-retest reliability=0.79) [11]. A typical item for cognitive restructuring is, "When I am in pain, I say to myself that because of pain, I learn to appreciate painless conditions." Habitual a*cceptance of pain* was measured using the German version of the Chronic Pain Acceptance Questionnaire (CPAQ-D; Cronbach's α=0.87) [35; 40]. A typical item is, "Although things have changed, I am living a normal life despite my chronic pain."

In addition, participants completed the Beck Depression Inventory (BDI) [20; 32] and the Pain Sensitivity Questionnaire (PSQ; Cronbach's α=.92, test-retest reliability=.83) [46]. Participants are

asked to rate how painful certain conditions are on an eleven-point Likert scale. A typical item is, "Imagine you burn your tongue on a very hot drink." Pain sensitivity is an important variable in experimental pain studies, because high pain sensitivity may influence poor responding to instructions [8; 18].

Pretest

Two different female experimenters conducted the experimental sessions. Participants signed an informed consent form, were given the opportunity to ask questions, and were informed about the procedure and the application of the thermode. Before the pretest, participants had the opportunity to familiarize themselves with the procedure and to practice stopping the pain stimulus.

Stimulus material and outcome measures

Thermal stimuli between 32°C and 49°C were used to induce pain. Stimuli were delivered to the dominant forearm via a 3 x 3 cm peltier-based thermode (TSA II: Thermal Sensory Analyzer, Medoc Ltd, Israel). The thermal stimulus started at 32°C and rose with a slope of 0.3°C per second for heat stimuli. When participants were able to tolerate the stimulus until 49°C was reached, the thermode maintained its temperature for another thirty seconds and then automatically returned to the baseline temperature of 32°C. The thermode remained at the same place on the skin for pretest and posttest. Participants were asked to tolerate the stimulus as long as possible. Participants were instructed to stop the stimulus by clicking a computer mouse. Pain tolerance was operationalized as the time in seconds at which participants stopped the stimulus. Pain intensity was assessed using a 10 centimeter visual analogue scale (VAS) immediately after the termination of each stimulus. The minimum was anchored with 'no pain' and the maximum was anchored with 'worst imaginable pain.'

Instructional Set

Participants listened to one of the three instructions via headphones. Instructions were based on those from several prior studies in the field [19; 44; 45; 51]. All instructions were approved by several experts on pain treatments, mindfulness-based treatments, and CBT. Several pilot tests were conducted and instructions were modified after each trial according to experts' ratings. Furthermore, these instructions were tested in a prior study including healthy participants [29].

All instructions were approximately the same length (~600 words) and followed the same structure: patients were asked to write down three thoughts that had led to termination of pretest stimuli in order to work on these thoughts using the specific strategy. Next, a description of the strategy was given, followed by a request to remember the last time patients experienced increased pain in their daily lives. Typical thoughts about pain were described to the patients as examples. Next, patients were asked to write down an important life goal. A metaphor was described in which patients were asked to

imagine walking through a swamp with their life goal at the end of the swamp. After that, patients had the opportunity to practice the strategy for five minutes. Finally, patients were asked to summarize the instructions. In total, instructions lasted for approximately ten minutes.

Acceptance Instructions: it was explained that thoughts often initiate behavior, but that it is also possible to disengage oneself from these thoughts (*defusion*) through non-judgmental awareness (*mindfulness*) or acceptance. One method might be to regard thoughts as clouds in the sky. If thoughts can be accepted, they lose their control over behavior tendencies and do not inhibit *personal goals*. Within the exercise, participants were asked to write down the initial thoughts that led to ending the pretest pain stimulus in different colors and styles of lettering (*defusion*).

Cognitive Restructuring Instructions: it was explained that thoughts, feelings, and actions are related. It is possible to alter the appraisal of a situation so that feelings and behavior tendencies also change according to the reappraisal. Negative and dysfunctional thoughts can be replaced by more functional ones, and the new point of view results in increased freedom of action. Within the exercise, patients were asked to develop arguments for and against the thoughts that had led to stopping the pretest pain stimulus, and were asked to develop alternative thoughts. Patients were also asked to imagine what they would advise a good friend to do in this situation.

Control condition: after having written down three thoughts, patients listened to a newspaper article about the university´s botanical garden. Participants were not asked to engage in any cognitive exercises following the article. Accordingly, the control condition was not meant to distract participants from proximate pain stimulation. They were asked to tolerate the next stimulus for as long as possible.

Credibility rating

Patients were asked to complete the Credibility/Expectancy Questionnaire (CEQ) [6] after the experimental instructions (acceptance and restructuring) and before the posttest for manipulation check purposes. Internal consistency of the English version was high (Cronbach's $\alpha > 0.84$). The questionnaire was translated into German and the word "therapy" was replaced by the word "instruction."

Posttest

Following the instructions (approximately ten minutes after pretest), heat stimuli were applied a second time. Participants stopped the thermal stimulus by a mouse click when no longer willing to tolerate it and were asked to rate pain intensity on the VAS afterwards.

After posttest, participants completed manipulation check questionnaires assessing the extent to which the instructions were applied ('adherence to instructions,' rated as a percentage). In addition, patients indicated a) whether they had tolerated the pain stimulus longer than during pretest and b) whether they experienced less pain during posttest on two four-point Likert scales.

Results

Statistical Analysis

All analyses were performed using the Statistical Package for Social Sciences (SPPS, Windows Version 19).

Seventeen patients were excluded for cold pain tolerance calculations because of floor effects at pretest.

To assess the differential effects of instructions on pain tolerance and pain intensity, we performed separate analyses of covariance (ANCOVA) for each outcome measure with instructions as three-factor independent variables, posttest data as dependent variables, and pretest data, BDI, PSQ, and age as covariates. We controlled for depression, pain sensitivity, and age, because these variables may theoretically be related to pain tolerance and intensity [3; 12; 46].

Post hoc tests were conducted to identify differences among the three types of instructions.

The use of ANCOVAs is recommended to enhance the power of a test relative to a repeated measures ANOVA [38]. Due to our expectation that differences among groups would be rather small, we chose to use ANCOVA.

We investigated whether heat and cold pain intensity were reduced by more than 30% at posttest compared to pretest, as recommended by Dworkin and colleagues [7]. Subsequently, responders were defined as those whose pain intensity was reduced by at least 30%. We analyzed the percentage of responders in each condition. Participants (n=3 participants for heat pain; n=4 participants for cold pain) who rated pain intensity at pretest as "not painful at all" were excluded.

Baseline characteristics

No significant group differences were found in any of the baseline measures (e.g., age, self-report measures) or in the pretest scores of pain tolerance and intensity; thus, the randomization appeared to be successful. For further details see Tables 1-5.

Table 1. Sample characteristics

	Acceptance (n=19) M (SD)	Cognitive restructuring (n=20) M (SD)	Control group (n=21) M (SD)	F-Value [e]	Total Sample (N=60) M (SD)
Age	52.0 (6.69)	48.3 (10.31)	53.9 (10.01)	1.95	51.4 (9.35)
BDI [a]	16.5 (10.59)	18.7 (9.5)	19.5 (7.78)	0.55	18.3 (9.24)
PSQ [b]	4.5 (1.95)	4.6 (1.7)	4.4 (1.76)	0.09	4.5 (1.77)
VAS today	6.2 (2.07)	5.5 (2.16)	6.0 (1.83)	0.62	5.9 (2.0)
VAS 4 weeks	6.5 (1.68)	5.9 (1.6)	5.9 (1.41)	0.95	6.1 (1.56)
CPAQ-D [c]	54.3 (18.31)	61.1 (16.75)	61.4 (13.58)	1.17	59.0 (16.3)
FESV-cognitive restructuring [d]	16.2 (3.42)	14.1 (5.01)	14.5 (4.39)	1.24	14.9 (4.36)
Room temperature	22.3 (2.19)	22.6 (2.28)	22.2 (1.35)	0.29	22.4 (1.95)

[a] Beck Depression Inventory II
[b] Pain Sensitivity Questionnaire
[c] Chronic Pain Acceptance Questionnaire (German version)
[d] FESV, cognitive restructuring subscale
[e] all F-values are non-significant ($p > 0.05$)

Table 2. Means and standard deviations at pretest and posttest for heat pain tolerance

Pain tolerance (time in sec)	**Acceptance** (n = 19)	**Cognitive restructuring** (n = 20)	**Control** (n = 21)	**F-value**
Pretest	51.64 (8.32)	49.75 (12.2)	45.43 (13.84)	1.48
Posttest	58.6 (5.16)	58.52 (8.53)	51.16 (15)	
Estimated Marginal Means [a]	57.47 (1.76)	58.88 (1.72)	51.84 (1.72)	

[a] Standard errors in parentheses

Table 3. Means and standard deviations at pretest and posttest for cold pain tolerance

Pain tolerance (time in sec)	**Acceptance** (n = 15)	**Cognitive restructuring** (n = 12)	**Control** (n = 16)	**F-value**
Pretest	87.98 (39.12)	67.42 (30.26)	68.47 (38.83)	1.44
Posttest	109.9 (31.86)	100.97 (44.81)	81.69 (44.37)	
Estimated Marginal Means [a]	98.11 (6.54)	111.24 (7.12)	85.04 (6.24)	

[a] Standard errors in parentheses

Table 4. Means and standard deviations at pretest and posttest for heat pain intensity

Pain intensity (VAS)	**Acceptance** (n = 19)	**Cognitive restructuring** (n = 20)	**Control** (n = 21)	**F-value**
Pretest	62.32 (21.17)	62.75 (22.62)	55.29 (32.37)	0.53
Posttest	67.68 (25.31)	70.05 (19.84)	72.71 (27.23)	
Estimated Marginal Means [a]	66.0 (3.82)	67.7 (3.79)	76.48 (3.7)	

[a] Standard errors in parentheses

Table 5. Means and standard deviations at pretest and posttest for cold pain intensity

Pain intensity (VAS)	**Acceptance** (n = 19)	**Cognitive restructuring** (n = 20)	**Control** (n = 21)	**F-value**
Pretest	66.84 (19.5)	53.2 (33.42)	53.19 (30.58)	1.47
Posttest	57.58 (28.3)	47.3 (37.7)	61 (33.02)	
Estimated Marginal Means [a]	49.8 (5.34)	49.87 (5.23)	65.59 (5.05)	

[a] Standard errors in parentheses

Pain tolerance

Heat Pain

Means and standard deviations for heat pain tolerance (time in seconds) at pretest and posttest for the three conditions are listed in Table 2.

The ANCOVA identified a significant effect of instruction condition on heat pain tolerance at posttest [$F(2, 53) = 4.41$, $p < 0.05$, *partial* $\eta^2 = 0.145$] when controlling for pretest scores, age, depression, and pain sensitivity. Pair-wise post-hoc analyses revealed significant differences between the cognitive restructuring and control groups for heat pain tolerance ($p < 0.01$), favoring cognitive restructuring. Acceptance instructions also led to significantly higher pain tolerance compared to control instructions ($p < 0.05$). Heat pain tolerance at posttest did not differ between the acceptance and cognitive restructuring conditions ($p = 0.567$; see Figure 1).

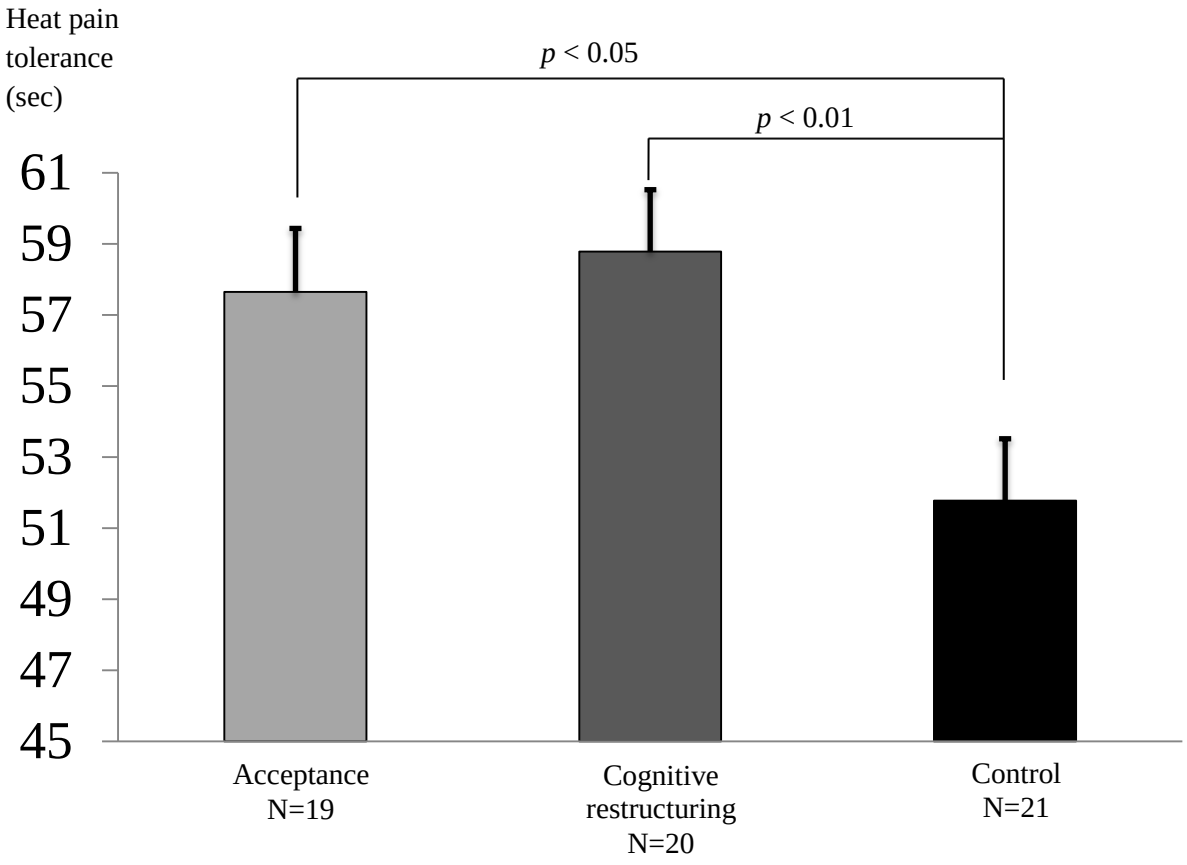

Figure 1. Estimated Marginal Means and standard errors for heat pain tolerance in seconds

In sum, instructions to accept thoughts and feelings related to painful stimuli and instructions to alter the appraisal of such situations prolonged the tolerance of painful stimuli more than the control task (listening to a newspaper article).

Cold Pain

Means and standard deviations for cold pain tolerance (time in seconds) at pretest and posttest for the three conditions are listed in Table 3.

The ANCOVA revealed a significant effect of instruction condition on cold pain tolerance at posttest [$F(2, 36) = 3.8$, $p < 0.05$, *partial* $\eta^2 = 0.11$] when controlling for pretest scores, age, depression, and pain sensitivity.

Pair-wise post-hoc analyses showed that cognitive restructuring led to higher cold pain tolerance than did the control task ($p < 0.01$), while acceptance did not differ from the control condition ($p = 0.17$). No significant difference was found between acceptance and cognitive restructuring ($p = 0.191$; see Figure 2).

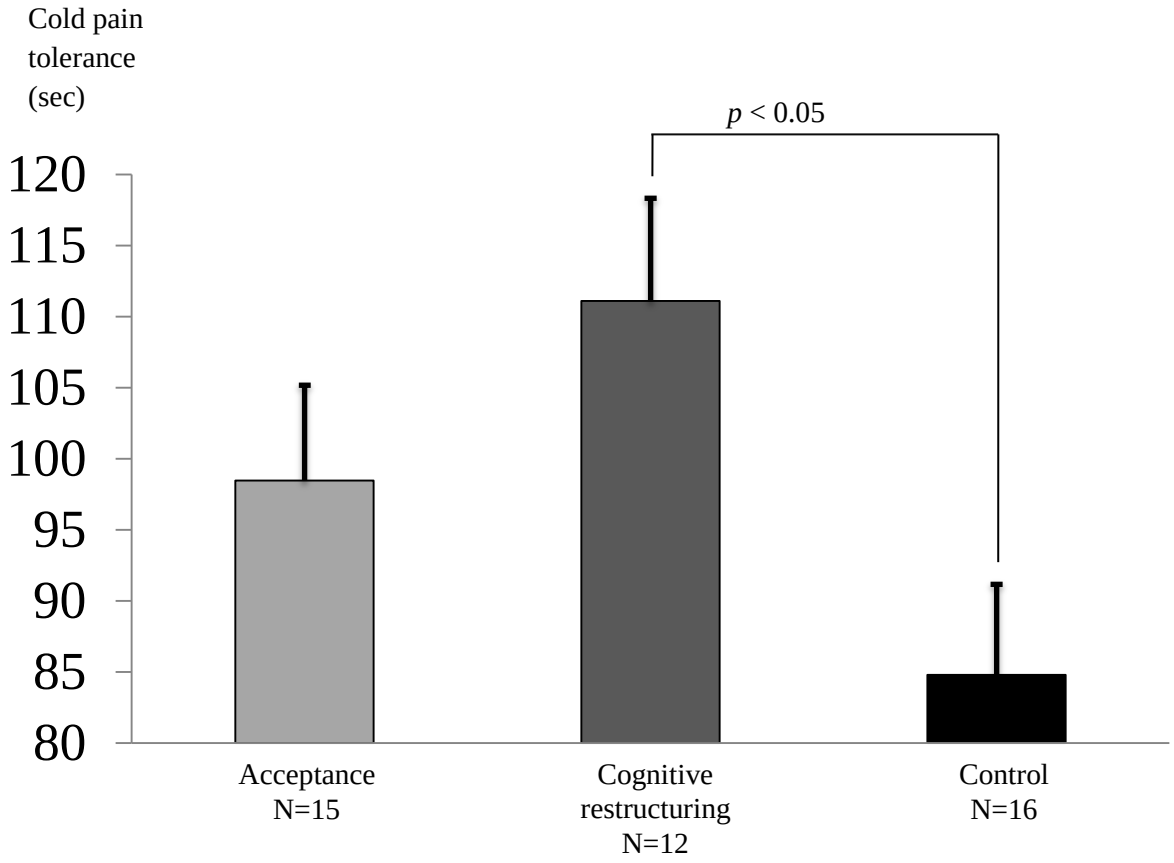

Figure 2. Estimated Marginal Means and standard errors for cold pain tolerance in seconds

Thus, changing the appraisal of pain-related thoughts led to higher cold pain tolerance than listening to a newspaper article, while accepting thoughts and feelings related to pain did not increase pain tolerance.

Pain intensity

Heat pain intensity

Table 4 shows means and standard deviations for heat pain intensity (VAS) at pretest and posttest for the three instructions.

Controlling for pretest scores, age, depression, and pain sensitivity, the ANCOVA indicated no significant effect of instruction condition on pain intensity at posttest [$F(2,53) = 2.2$, $p = 0.121$].

Heat pain intensity decreased by more than 30% between pretest and posttest among 5.3% of participants in the acceptance condition and among 5% of participants in the cognitive restructuring condition. None of the participants in the control condition experienced more than a 30% decrease in pain intensity (see Figure 3).

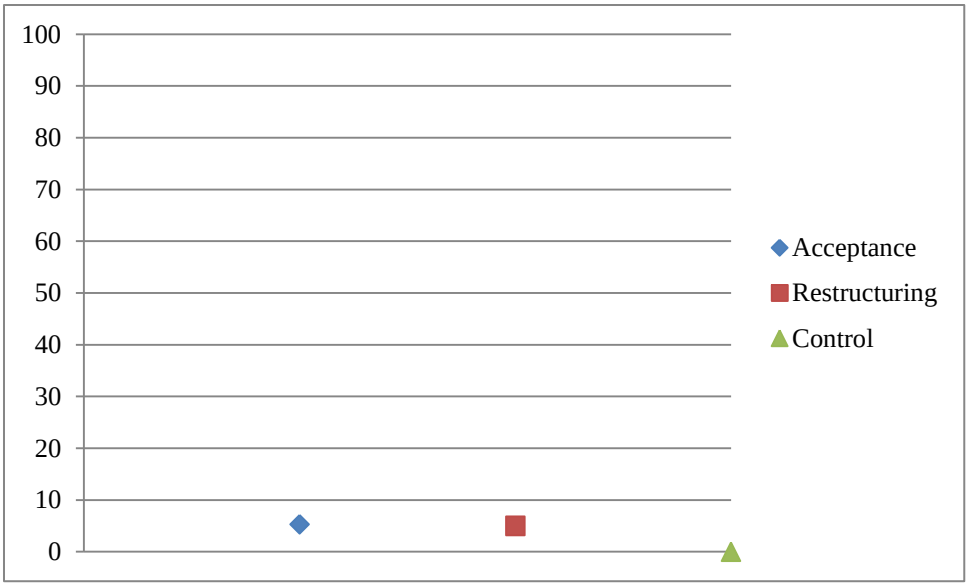

Figure 3. Responder analysis for heat pain intensity

Cold pain intensity

Table 5 shows means and standard deviations for cold pain intensity (VAS) at pretest and posttest for the three instruction conditions.

An ANCOVA indicated no significant effect of instruction condition on cold pain intensity at posttest [$F(2,53) = 3.1$, $p = 0.53$] when controlling for pretest scores, age, depression, and pain sensitivity.

In the cognitive restructuring condition, 33.3% of participants experienced a reduction in cold pain intensity of more than 30%. Cold pain intensity decreased by more than 30% among 26.3% of participants in the acceptance condition, while none of the participants in the control condition experienced more than a 30% decrease in cold pain intensity (see Figure 4).

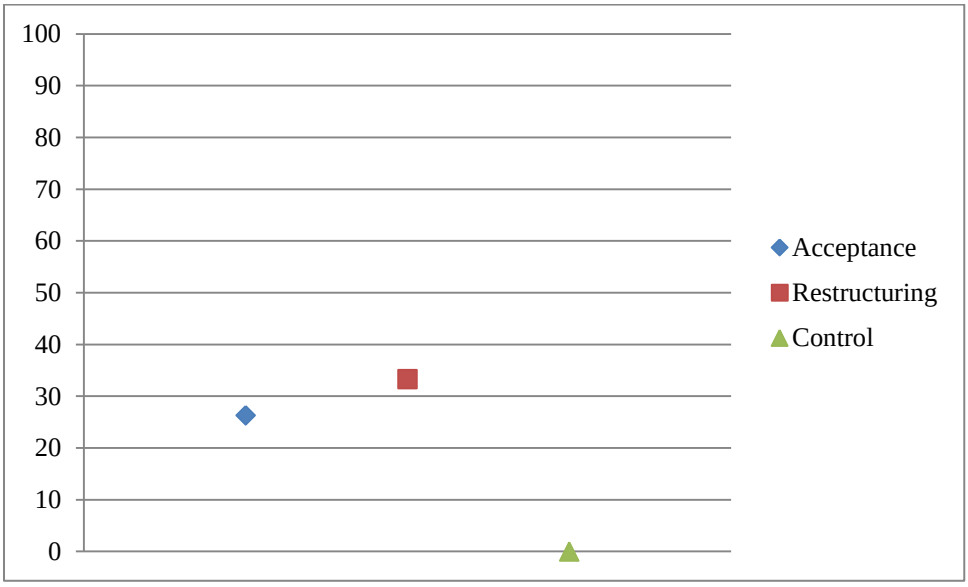

Figure 4. Responder analysis for cold pain intensity

Manipulation check

No differences between acceptance and cognitive restructuring instructions were found for either credibility ratings or adherence to instructions (see Table 6).

Table 6. Manipulation check

	Acceptance (n=19)	**Cognitive restructuring (n=20)**	**F-Value** [e]
CEQ-credibility (mean, SD)	19.74 (3.8)	18.25 (4.89)	1.12
Adherence to instructions as % (mean, SD)	56.74 (27.91)	70.5 (26.65)	2.48

[e] all F-values are non-significant ($p > 0.05$)

Influence of pain sensitivity

We performed partial correlation analyses between heat pain tolerance at posttest and pain sensitivity (PSQ) within each group by controlling for heat pain tolerance at pretest. In the cognitive restructuring condition, a significant negative correlation was found between heat-pain tolerance at posttest and pain sensitivity ($r = -0.519$, $p < 0.05$) when controlling for heat pain tolerance at pretest.

No significant correlations were found in the acceptance group ($r = -0.092$, $p = 0.715$).

Discussion

Summary and comment on the main findings

The aim of the present study was to clarify the effectiveness of mechanisms of psychological fibromyalgia treatment (such as acceptance and cognitive restructuring) by inducing heat and cold pain tolerance and intensity.

Results indicated that fibromyalgia patients responded to both cognitive restructuring and acceptance by significantly enhancing their acute heat pain tolerance relative to the control group. Responder analyses revealed that up to 30% of patients in the experimental conditions experienced decreases of more than 30% in thermal pain intensity, while none of the participants in the control group experienced reductions in pain intensity of this magnitude. Moreover, our results suggest a small advantage of cognitive restructuring over acceptance for enhancement of pain tolerance in fibromyalgia patients. We found that high pain sensitivity was negatively associated with successful application of cognitive restructuring, but was not associated with application of acceptance.

Comparison with previous studies

To the best of our knowledge, this is the first study to experimentally compare different pain coping strategies in a sample of fibromyalgia patients [30]. Only one study examined this topic in a sample of pain patients [30; 51]. Another study was the first one that has compared cognitive restructuring to acceptance with respect to pain tolerance and intensity using healthy participants [29].

In a recent meta-analytic review, our research group concluded that acceptance is particularly effective in clinical samples with respect to negative affect [31]. However, in contrast to this conclusion and to the results of our previous study [29], we did not find that acceptance led to a significantly greater increase in pain tolerance than did cognitive restructuring [29].

Other studies have yielded mixed results on the relative efficacy of acceptance and cognitive restructuring at modifying other outcome variables such as anger, anxiety, or food cravings [10; 24; 47]. Research suggests that acceptance strategies may have the greatest impact when the strategy is embedded in a values-based context [2; 43] or when acceptance instructions involve metaphors and exercises [37]. Although we followed these recommendations, we did not replicate this result. One explanation for this discrepancy may be that fibromyalgia patients, in comparison to highly educated student samples, may have found the cognitive restructuring instructions easier to follow, since the concept of acceptance is less common in Western cultures. Acceptance might require more than the limited practice time to optimize its effectiveness. In addition, twenty-eight percent of the patients were excluded from analyses of cold pain tolerance due to floor effects at pretest, which may have led to inadequate power for these analyses.

Means of pain intensity ratings were lower for cold pain than for heat pain, which is important given a prior finding that an acceptance instruction increased pain tolerance only when pain intensity was high

[19]. Therefore, the fact that acceptance was not superior to the control condition with respect to cold pain tolerance may be explained by lower pain intensity.

In line with previous results, we did not find significant differences between acceptance and cognitive restructuring strategies for pain intensity [29]. Furthermore, neither acceptance nor cognitive restructuring differed from the control condition in pain intensity analyses. Average heat pain intensity increased in all groups from pre- to posttest, which indicates that participants were sensitized to heat pain during the experiment. Participants were less successful at modulating pain intensity relative to pain tolerance. A possible explanation for this effect is that successfully extending pain tolerance, which was the explicit instruction, might have resulted in higher pain intensity.

Although statistical analysis did not reveal any significant differences, we found that none of the participants in the control condition experienced reductions in pain intensity of more than 30%, while 5-30% experienced such reductions in the two experimental conditions. While the heat pain became more intense on average, 5% of patients in both experimental conditions were able to reduce heat pain intensity by more than 30%. Reductions of 30% in pain intensity is commonly found in RCTs on CBT in chronic back pain [15] and is therefore a remarkable result for a short experiment.

Some prior studies have found differences in pain intensity among different pain regulation strategies [2; 19; 28; 29; 34; 44], while others have not [21; 37; 43; 45]. Interestingly, the only previous study that has investigated pain regulation strategies in chronic pain patients within an experimental setting did not find group differences [51]. A possible explanation for this null finding is that chronic pain patients may have learned that they cannot influence their pain and thus have lower self-efficacy. Another explanation may be that chronic pain patients are in need of a longer series of interventions in order to change a long-established perception of pain. Moreover, standard deviations of heat pain intensity ratings indicated higher heterogeneity in the clinical sample than in a student sample [29], even when looking at estimated marginal means in which the influence of age is controlled, indicating that across fibromyalgia patients acute pain is perceived differently.

Advantages

This is the first study to investigate the effects of cognitive restructuring and acceptance as short-term pain regulation strategies in a sample of chronic pain patients. Due to differences in processing and experiencing pain [13; 17], results drawn from studies including only healthy participants cannot be generalized to chronic pain patients. In addition, inducing pain in the forearm is more relevant to fibromyalgia patients, who suffer from widespread pain, than to healthy participants or to low back pain patients, suggesting that the study has high external validity.

Pre-treatment pain intensity ratings of more than 50 on a 0-100 scale indicate that the pain, although only acute and artificial, was experienced as significant. Nevertheless, a substantial proportion of the participants successfully applied cognitive restructuring and acceptance strategies to tolerate or even

reduce pain after only ten minutes of training. Participants adhered to the instructions by 56-70% and found them credible. These results suggest that fibromyalgia patients are able to respond to cognitive restructuring and acceptance instructions, thereby suggesting that treatments based on these strategies may be effective at treating fibromyalgia pain.

This study also included a control condition, in order to rule out the possibility that changes were obtained due to habituation processes and therefore, extends prior research. Moreover, we assessed pre-experimental, habitual pain regulation strategies with the aim of entering habitual pain regulation strategies as covariates in the event that randomization was unsuccessful. We found that pain sensitivity may be a predictor of response to a specific strategy. Another strength of the study is the broad age range, because age is associated with an altered pain system [9; 12] and the age range is often limited in healthy samples.

Limitations

Because prior studies have found differences in pain perception between men and women and between fibromyalgia patients and other chronic pain patients, our results may not generalize beyond female fibromyalgia patients. Furthermore, the generalizability of experimental results from acute pain to chronic pain may be limited. The sample size of the present study, although larger than in most other studies [30], would not have been sufficient to detect small group differences.

Moreover, the present results describe short-term effects of experimental interventions, and no conclusions can be drawn regarding a) long-term influences of acceptance and cognitive restructuring among fibromyalgia patients and b) the efficacy of the strategies applied in a therapeutic context. Therapeutic confounders may either restrict or enhance the effectiveness of a particular strategy.

Clinical implications and future research

One might argue that targeting pain intensity in chronic pain patients is less important than enhancing pain tolerance. The main goal of psychological treatment is to reduce disability, not to reduce pain intensity, although pain intensity is commonly regarded as one of the primary outcomes [7]. Chronic pain patients are striving for pain relief, and thus additional studies should investigate strategies for influencing nociceptive pain perception.

Effect sizes for group differences among adaptive pain regulation strategies, such as distraction, acceptance and cognitive restructuring, are only small to medium. Therefore, the question of whether treatment should be individually tailored seems as much justified as the question of whether strategies differ. Prior studies have shown that fibromyalgia patients belong to a heterogeneous cluster in which patients display different psychophysiological response patterns [48; 49] and thermal pain thresholds [25]. An additional study demonstrated that variables such as pain behavior and physical impairment predict response to either operant or cognitive-behavioral treatments [50]. Taken together, we

recommend further investigation of possible moderators of the effectiveness of short-term pain regulation strategies within experimental designs.

Since pain sensitivity was associated with reduced responsiveness to cognitive restructuring, but not to acceptance, we suggest assessing pain sensitivity in fibromyalgia patients before selecting a psychological treatment strategy. This finding represents an initial step towards tailoring treatment to specific patient characteristics.

The fact that fibromyalgia patients responded differently to the instructions than did healthy participants highlights the importance of experimentally studying pain not only in healthy individuals, but also in chronic pain populations.

Disclosure

There is no actual or potential conflict of interest for any of the authors.

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D: Curriculum Vitae und Publikationsliste

Die Seiten 107-108 enthalten persönliche Daten (Lebenslauf) und sind deswegen nicht in der Online-Veröffentlichung enthalten.

E: Eidesstattliche Erklärung

Ich versichere, dass ich meine Dissertation „Die Effektivität von experimentellen Akzeptanzstrategien bei akutem Schmerz" selbständig, ohne unerlaubte Hilfe angefertigt und mich dabei keiner anderer als der von mir ausdrücklich bezeichneten Quellen und Hilfen bedient habe. Die Dissertation wurde in der jetzigen oder einer ähnlichen Form noch bei keiner anderen Hochschule eingereicht und hat noch keinen sonstigen Prüfungszwecken gedient.

Marburg, September 2012 Annika Maria Kohl